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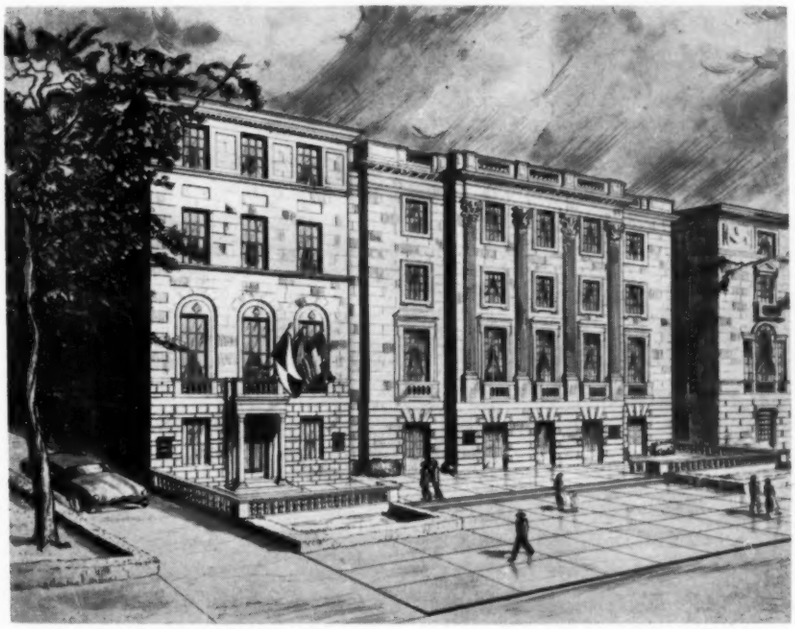

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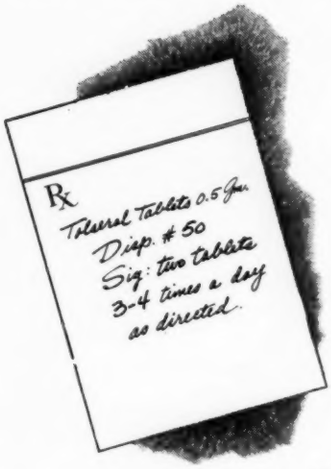

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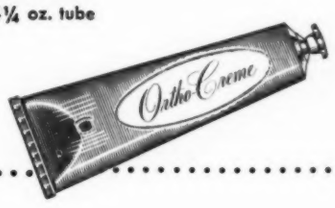

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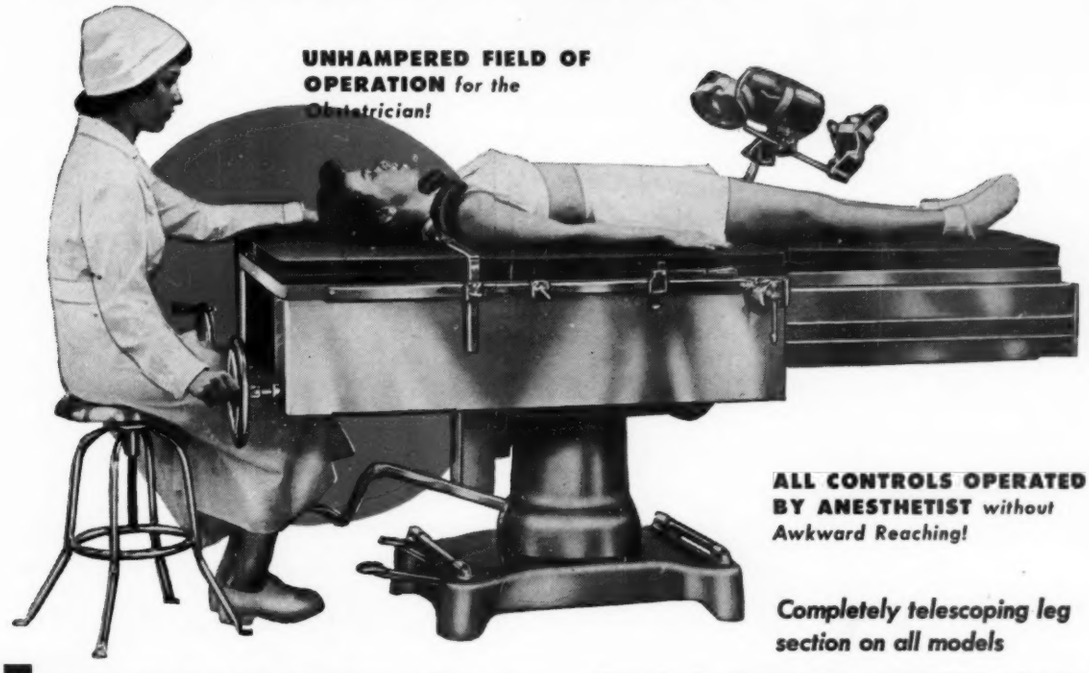

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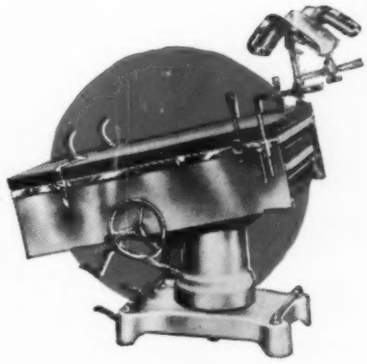

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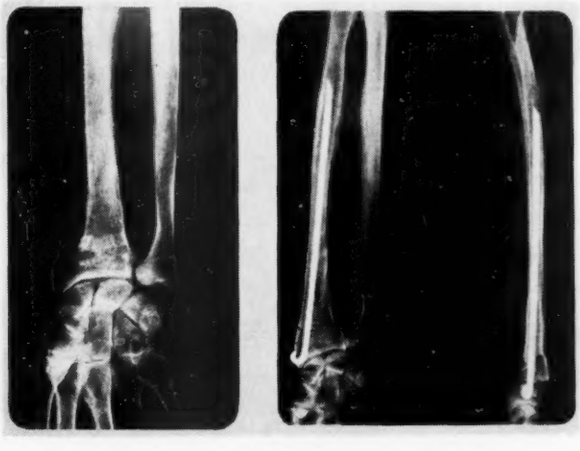

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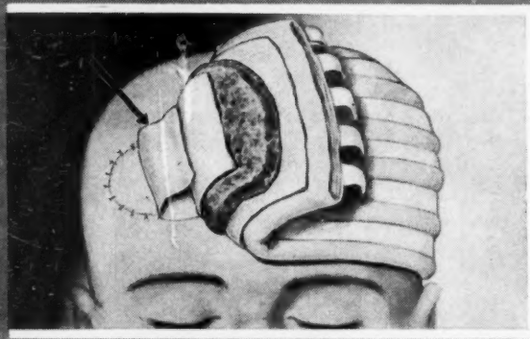

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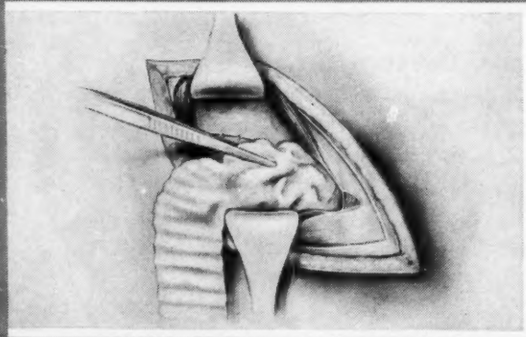

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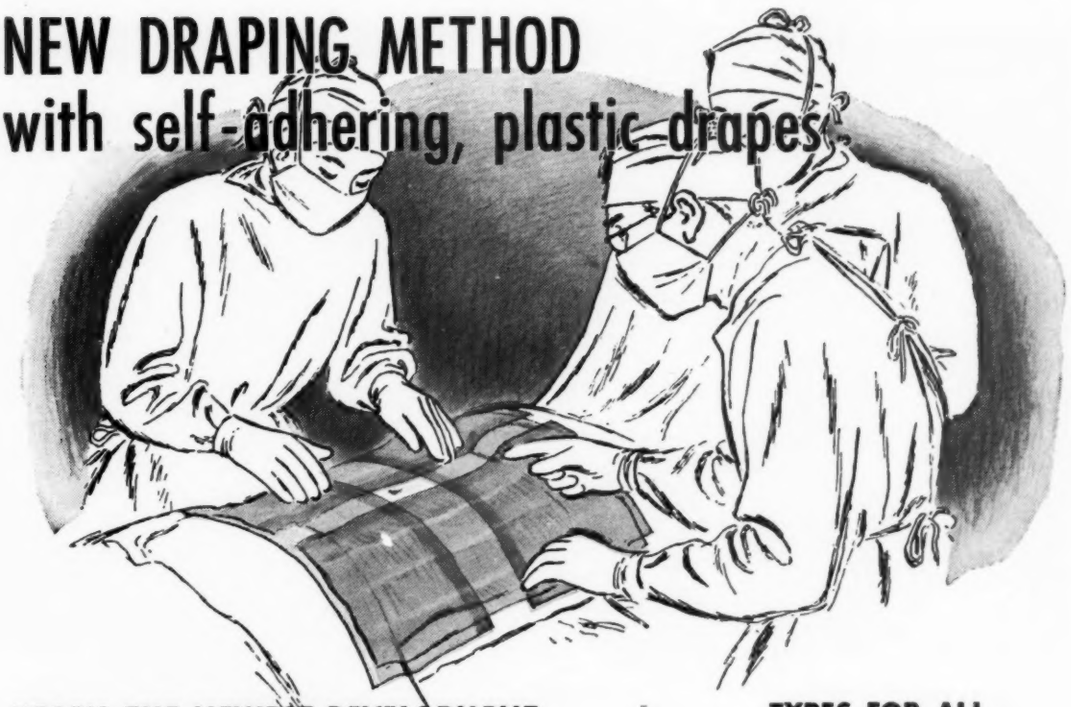

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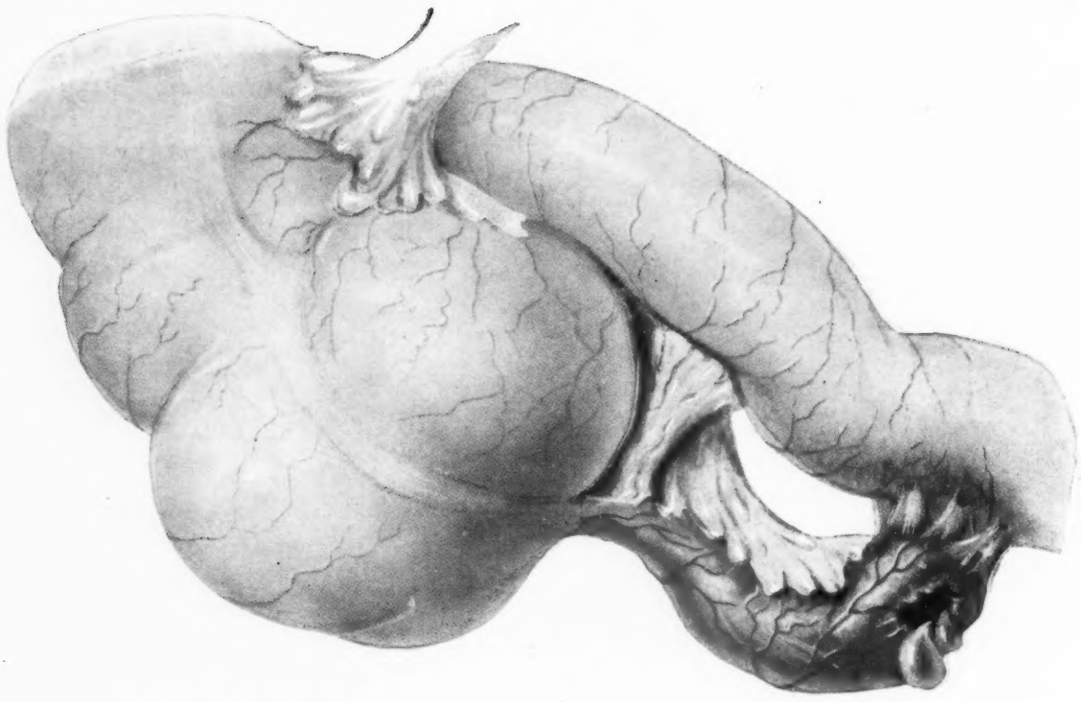

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Indications CREMOTHALIDINE is indicated in inflammatory conditions of the colon; as an adjunct in the management of ulcerative colitis; for use before and after colon surgery, to reduce risk of peritonitis.

Average Dose for adults: 1 to 2 teaspoonfuls four times daily. For children: ½ to 1 teaspoonful four times daily. For infants: ½ to 1 teaspoonful three times daily.

Packaging CREMOTHALIDINE is supplied in Spasaver® bottles of 8 fluidounces. Sharp & Dohme, Philadelphia 1, Pa.

CREMOTHALIDINE®

Sulfathalidine® Suspension

orthoxine hydrochloride

The bronchodilating, antispasmodic and decongestive effects of Orthoxine* Hydrochloride [beta- (orthomethoxyphenyl) - isopropyl-methylamine hydrochloride] are useful in the treatment of bronchial asthma. In usual therapeutic and prophylactic doses Orthoxine Hydrochloride exerts minimal vasopressor, cardiac and central nervous system side effects.

Supplied in 100 mg. scored tablets in bottles of 100 and 500.

**Trademark, Reg. U. S. Pat. Off.*

Upjohn *Medicine...Produced with care...Designed for health*

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The Pilling

PORTABLE PUMP

FOR SUCTION AND PRESSURE

- Easy to operate—simple to control
- Large, easy-to-read suction and pressure gauges
- Readily accessible regulating valves
- Completely portable, yet stays firmly in position while in use

The sturdiest and most useful pump of its size available—at a price that cannot be matched.

The Pilling Portable Pump will give yeoman's service all through the hospital. It is ideal for office, hospital bedside and even house-call use . . . easily carried wherever it's needed—no trouble at all to maintain.

Supplied complete with suction and pressure hoses. 110 volts, 60 cycles, AC.

Only **$95.00**

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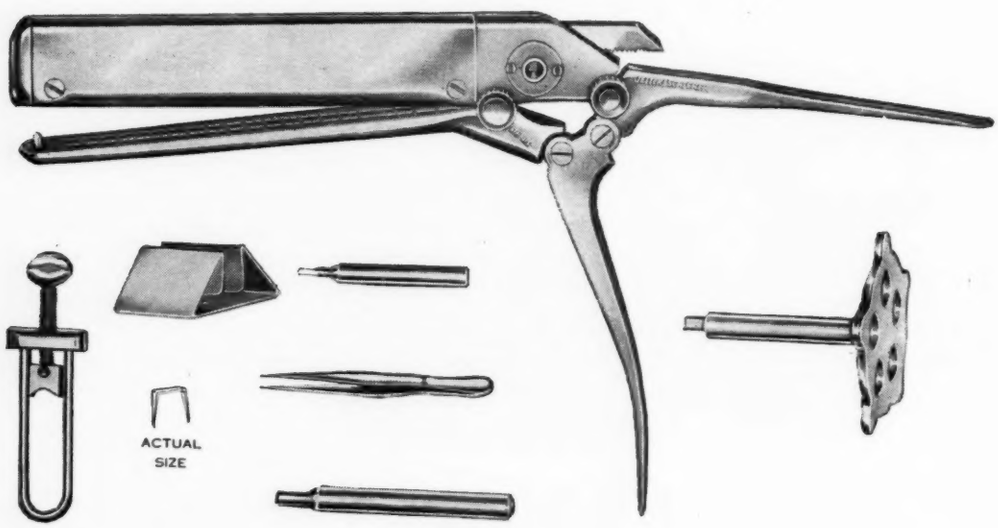
INTESTINAL SUTURING INSTRUMENT



For Gastric and Intestinal Surgery—

Rapid, sure and aseptic application of the first closing stitches at a depth in places which are deep or difficult to reach without danger of spreading infectious contents of stomach or intestines, can easily be effected with this ingenious apparatus.

This INDISPENSABLE adjunct in stomach and intestinal surgery speedily applies two rows of protective suture clips, ½ cm. apart, between which the cut can be safely made. Suture clips drop inside intestinal tract and are evacuated. Gear-operated Magazine Clip Holder in broad, rigid upper blade. Thin lower blade contains shallow cavities to approximate clips in use.

The latest pattern of the large clamp is made entirely of STAINLESS STEEL, highly polished, not plated. The accessories are made of carbon steel, chrome plated. Another refinement consists of two holes in the sheath over the upper jaw of the clamp for lubricating the gear rod, gear box and the lugs which drive the nickel silver clips into the tissues.

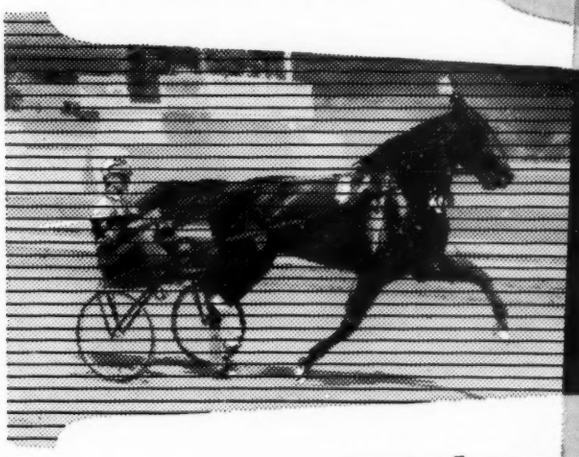
Complete in hardwood case with space for extra clamp with accessories shown and 300 Suture Clips.

Sold only through the established Surgical Instrument Houses in the United States and Canada

JETTER & SCHEERER PRODUCTS, INC. 251 Fourth Avenue, New York 10, N.Y.

SOLE MANUFACTURERS IN THE UNITED STATES

even in stubborn
slow healing **wounds**
burns
ulcers
(decubitus, varicose, diabetic)



accelerates healing

New clinical studies[1] again prove the ability of Desitin Ointment to ease pain, inhibit infection, stimulate healthy granulation, and accelerate smooth epithelization in lacerated, denuded, ulcerated surface tissues . . . often in conditions resistant to other therapy.

protective, soothing, healing **Desitin Ointment** is a self-sterilizing blend of high grade, crude Norwegian cod liver oil (with its unsaturated fatty acids and high potency vitamins A and D in proper ratio for maximum efficacy), zinc oxide, talcum, petrolatum, and lanolin. Does not liquefy at body temperature and is not decomposed or washed away by secretions, exudate, urine or excrements. Dressings easily applied and painlessly removed. Tubes of 1 oz., 2 oz., 4 oz., and 1 lb. jars.

write for ***samples*** *and reprint*

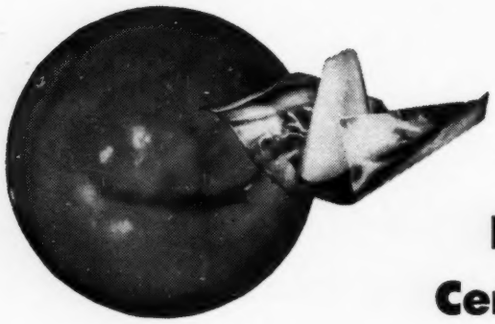
Desitin CHEMICAL COMPANY
70 Ship Street, Providence 2, R. I.

1. Behrman, H. T., Combes, F. C., Bobroff, A., and Leviticus, R.: Ind. Med. & Surg. 18:512, 1949.

TO DECREASE DRAINAGE

TO MINIMIZE MALODOR

TO FACILITATE HEALING



Discharge and malodor of bacterial cervicitis and vaginitis can be markedly decreased by Furacin Vaginal Suppositories.

When the infection is accessible to vaginal medication, it is usually promptly eradicated by the powerful antibacterial action of Furacin, whose spectrum includes many gram-negative and gram-positive organisms.

When cauterization or conization of the cervix is indicated, use of Furacin Vaginal Suppositories pre- and post-operatively is reported to produce cleaner, faster healing with less slough and drainage.

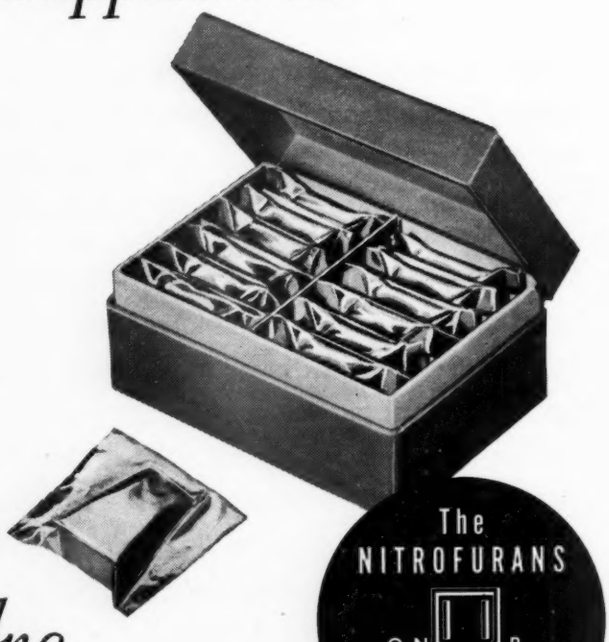
New Therapy in Cervicitis & Vaginitis

Furacin Vaginal Suppositories

Furacin® Vaginal Suppositories contain Furacin 0.2%, brand of nitrofurazone N.N.R. in a base which is self-emulsifying in vaginal fluids and which clings tenaciously to the mucosa. Each suppository is hermetically sealed in foil which is leak-proof even in hot weather. They are stable and simple to use.

These suppositories are indicated for bacterial cervicitis and vaginitis, pre- and postoperatively in cervical and vaginal surgery.

Literature on request



The NITROFURANS

A unique class of antimicrobials

EATON LABORATORIES Inc.

NORWICH, NEW YORK

A GUIDE FOR NATURE'S REPAIR OF FRACTURED BONES

EGGERS TYPE

VITALLIUM®

INTERNAL CONTACT SPLINT

Encourages earlier bony union . . . assures optimum placement of screws . . . provides fully adequate fracture support.

Vitallium Internal Contact Splints are slotted bone plates—permitting fractured bone ends to move together and to be in constant contact under muscular pressure when concurrent necrosis, absorption and osteogenesis of the traumatized bone ends occur. They keep the fractured bone in longitudinal alignment and provide lateral stability. Fragments are locked securely, and rotation is hindered by the combination of longitudinal muscular pull and screw fixation.

The Eggers splints thus serve as guides for nature's repair of fractured bones. Under the influence of splinting, compression, and contact, mechanical and physiological conditions favorable to early bone union are created.

The slots in the plates facilitate placing the screws in the most desirable locations—as far from the fracture site as possible. Loose bone fragments may be engaged firmly with additional screws.

ORDER THROUGH YOUR SURGICAL DEALER

Available in lengths of 3", 4", 5" and 6" with Eggers type screws.

References: "Internal Contact Splint" —Eggers, G.W.N.
Jour. Bone & Joint Surg., 30-A, No. 1, Jan. 1948
"The Influence of The Contact-Compression Factor on Osteogenesis in Surgical Fractures" — Eggers, G.W.N., Shindler, T.O. and Pomerat, C.M.,
Jour. Bone & Joint Surg., 31-A, No. 4, Oct. 1949

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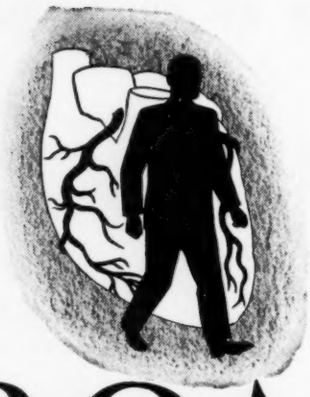

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TROMEXAN T. M.

ethyl acetate

new, safer, oral anticoagulant

Throughout the exhaustive studies on TROMEXAN, involving many hundreds of cases, this new anticoagulant has proved singularly free from the dangers of hemorrhagic complication. Other advantageous clinical features of TROMEXAN are:

1 ***more rapid therapeutic response***
(therapeutic prothrombin level in 18-24 hours);

2 ***smooth, even maintenance of prothrombin level***
within therapeutic limits;

3 ***more rapid return to normal***
(24-48 hours) after cessation of administration.

In medical and surgical practice . . . as a prophylactic as well as a therapeutic agent . . . TROMEXAN extends the scope of anticoagulant treatment by reducing its hazards.

Detailed Brochure Sent on Request.

TROMEXAN (brand of ethyl biscoumacetate): available as uncoated scored tablets, 300 mg., bottles of 50 and 250.

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$\frac{dx}{dC} = K_0(S-x)^{e-AT}$

$\frac{dx}{dC} = K(S-x)$

$\frac{a-x}{v}$

$\log \frac{S}{S-x} - 0.4343\frac{x}{S} = \frac{c}{K}$

It's *simply* physical

$\frac{S}{S-x} = KC$

$\frac{S}{S-x} - Ax = KC$

$\frac{a-x}{v} S = Ke^{\frac{A(S-x)}{S}x}$

$k - \frac{dx}{dc} = \frac{S-x}{x^m}$

$\frac{S}{S-x} - Ax = KC$

Diarrhea control does not require complex equations denoting physical adsorptive powers for toxins and bacteria, physical coating potentials, or hydrophilic capacity for physically consolidating stools.

℞ To achieve these goals quickly in diarrheal disturbances precipitated by dietary indiscretions, spoiled foods or intestinal allergies, the therapeutic equation simply calls for *physically* effective . . .

Kaopectate*

Each fluid ounce contains:

Kaolin	90 grs.
Pectin	2 grs.

Available in bottles of 10 fluid ounces.

Dosage: ADULTS — 2 or more tablespoons after each bowel movement, or as indicated.

CHILDREN — 1 or more teaspoons according to age.

*Trademark, Reg. U.S. Pat. Off.

Upjohn *Medicine . . . Produced with care . . . Designed for health*

MICHIGAN

Outside the Ivory Tower

"MOTHER and child doing well" was reported in a higher percentage of maternity cases last year than ever before in the nation's history. Estimates for 1950 by Metropolitan Life Insurance Company statisticians place maternal mortality at somewhat less than one per 1,000 live births and infant mortality at about twenty-nine per 1,000. As recently as 1938 the maternal mortality rate was 4.4 per 1,000 live births and the infant mortality rate—deaths during the first year of life—was fifty-one per 1,000 live births. "The fact that the declines occurred during a period of rising birth rates has added substantially to the number of lives saved among the mothers and babies," the statisticians note. In answer to the question as to how much safer maternity and infancy can become, it is pointed out that in 1948 Oregon had a maternal mortality rate of only 0.4 per 1,000 births, and Washington, Utah and Connecticut had rates that were only slightly higher.

"It now remains for the other states to do as well—and the goal is already within the reach of many," the statisticians comment. "The opportunities for life conservation are far greater among infants than among mothers; while puerperal causes take the lives of fewer than 4,000 women a year, close to 110,000 babies die before they reach their first birthday."

LATEST information on how to give emergency care to atomic casualties is provided in new supplementary training in American Red Cross first aid and home nursing, the organization announced. New teaching material for the courses, prepared in cooperation with the Federal Civil Defense Administration, has been released to Red Cross chapters throughout the country in the form of supplements to the standard first aid and home nursing textbooks. It is designed to bring the standard courses up to date. Release of the supplementary text material is the latest Red Cross step in its efforts to train millions of persons in first aid and hundreds of thousands in home nursing and as nurse's aides, as part of the nation's civil defense program. Two million copies of the first aid and one million of the home nursing supplements are being distributed initially. Of extreme importance, the text says, is the order in which large numbers of casualties are treated. Severe hemorrhage, asphyxia or serious breathing difficulty, and deep shock require immediate life-saving attention in that order. The common sense reminder to remove the injured from hazardous areas immediately is added.

A NEW edition of "Diagnostic Standards," long recognized throughout the world as the authoritative handbook on the diagnosis and classification of tuberculosis, has been issued by the National Tuberculosis Association. Revised under the direction of the NTA's medical section, the American Trudeau Society, this is the ninth edition of the book, the complete title of which is "Diagnostic Standards and Classification of Tuberculosis." It was first published in 1917 and was last revised in 1940.

COMPLETE figures on Navy Medical Corps casualties released January 18, 1951, list the first Navy doctor to be killed in action in Korea. Lieutenant Peter Emilio Arioli, USNR, of 2928 Derby Street, Berkeley, California, was one of thirty-eight Navy Medical Corps personnel who have been killed in Korea and the first Navy doctor to lose his life there. He was killed by sniper fire December 3, 1950, while serving with the First Marine Division. A total of 263 enlisted Navy Medical Corpsmen have been casualties while serving in support of Marines fighting in Korea. Of these, thirty-seven have been killed and ten are missing in action. Three Medical Corps officers have been wounded. All medical care for the Marine Corps is provided by the Navy.

TO study and eliminate any potential health hazards in the manufacture and use of new chemical products made from petroleum, Standard Oil Company (New Jersey) announced that its Medical Research Division will inaugurate a broad program of increased activities. New information obtained on toxic materials will be made available immediately to the medical profession, the company said. The Division, the only company-directed medical research unit in the petroleum industry, will be transferred from the Medical Department of Jersey Standard to its central research affiliate, the Standard Oil Development Com-

(continued on page 28)

The Surgeon's Mart

When you are in need of surgical instruments or medical supplies you will find the dealers and manufacturers listed below ready to serve you. For your guidance when purchasing supplies we submit this list.

SPECIALISTS

Plastic Instruments · Ear, Eye, Nose & Throat
Lempert Set · Orthopedic · Diagnostic

J. F. BEST, President
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DEPENDABLE QUALITY SERVICE

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COCHRANE PHYSICIANS' SUPPLIES, INC.
133 East 58th Street New York 22, N. Y.

PRECISION-ENGINEERED SURGICAL INSTRUMENTS AND ORTHOPEDIC APPLIANCES

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Colostomy & Ileostomy Patients

find MORE Convenience and Longer Service with PERRY APPLIANCES

NEW 1950 MODEL

Convertible to use as Colostomy or Ileostomy appliance, Irrigator, or Protector. New unique method of cementing to the body (optional). Permits use of latex OR disposable plastic bags. *Write for folder showing complete line.*

MURLE PERRY
112 Hennepin Avenue
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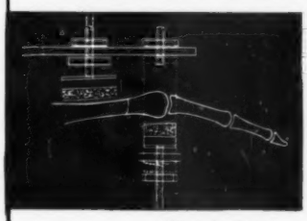
METACARPAL and THUMB FRACTURES



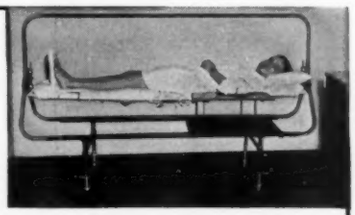
NEW TREATMENT NOW AVAILABLE

GOLDBERG METACARPAL SPLINT. A closed method of treating all types of Metacarpal Fractures including the Thumb.

Write for Literature and Reprints.

AMERICAN ORTHOPEDIC APPLIANCES
P. O. Box 31 Springfield, Mass.

STRYKER TURNING FRAME



A new development in the treatment of immobilized patients. While held firmly between two frames, the largest patient can be easily turned by the smallest nurse. Quickly elevated from either end. Easily transportable from hospital to ambulance. Essential for any modern hospital.

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FOR YOUR PROTECTION

TRADE MARK OF QUALITY

SOLE MANUFACTURER OF
COLLISON SURGICAL PRODUCTS

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COLOSTOMY & ILEOSTOMY APPLIANCES
Recommended by Distinguished Surgeons
Used in Leading Hospitals
IRRIGATORS, POUCHES, CUPS, BOWLS,
of different sizes & materials
Rubber—Plastic—Metal
Stock Models for immediate shipment
Disposable Liners

SPECIAL BAGS made to order in one week, with any size of opening desired. Real COMFORT, CONVENIENCE and DURABILITY may be had with appliances purchased from

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Only "CABLE WIRE"
the Multiple Strand Stainless Suture

Offers All These Advantages
- TIES LIKE SILK
- NON-CORROSIVE
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- EASY TO STERILIZE

Won't curl, twist or kink . . . and ties like silk.

Write Dept. M for liberal samples.

United

SURGICAL SUPPLIES CO.
160 E. 56th Street, New York 22

Outside the Ivory Tower

(*continued from page 26*)

pany. The move, effective February 1st, will enable the Medical Research Division to utilize the Development Company's many research and process development facilities in the detection and elimination of any health problems that might arise.

FOR the first time, a surgical glove is being announced to the profession that contains no rubber or synthetic rubber. For the past three years Vinyl gloves have been accepted and used by surgeons, and the demand for them has been growing by word of mouth. Watsolite Vinyl gloves are the only really absolutely non-allergic elastic gloves that have ever been developed and manufactured. This glove is not a war substitute because it was perfected and acclaimed before the war. Among the features of this new glove that appeal to the surgeon are: (1) The gauntlets do not droop, therefore, no garters nor binding of the surgeon's forearm is required; (2) they have a new feel and greater temperature sensitivity; (3) they are less slippery when wet and are unaffected by oils and fats. Most important, there has never been a single case of surgical glove allergy to date that has not been improved or healed by using Watsolite Vinyl gloves instead. The gloves are suggested in standard surgical weight "L" or "LL" sheer for those requiring the thinnest.

A DELETION theory of the formation of cancer was described to the Binghamton Section of the American Chemical Society by Harold P. Rusch, M.D., director of the McArdle Memorial Laboratory for Cancer Research in the University of Wisconsin Medical School. The theory is based on studies of cancer formation induced by a class of chemicals called azo dyes, according to Professor Rusch, who spoke on "Chemical Approaches to the Cancer Problem." These cancer-forming chemicals have been shown to delete protein from the livers of test animals, destroying the tissue cells' ability to carry out some of the specialized functions of normal liver cells, Professor Rusch reported. The affected cells, however, can still grow and multiply and, according to the theory, they are the cancer cells. "Most of the infectious diseases are curable," Professor Rusch said. "Diabetes can be controlled; yellow fever was conquered in a few years; in the recent war DDT quickly stopped the spread of typhus; other problems have been worked out by science—why not cancer?

"Simply because the key has not been found. Bacteria and viruses responsible for infectious diseases have been isolated, studied and often the disease reproduced in animals. With these methods it is possible to survey the inhibiting effect of a large number of compounds.

"But until twenty years ago basic clues for research into cancer eluded science. The discovery two decades ago of a pure chemical capable of reproducing cancer in animals was the first important key in the study of cancer, and opened the door to an entirely new era of investigation in this field.

"Once a carcinogen (cancer-forming agent) was found, the discovery of others followed in rapid succession, and by 1940 some 400 chemicals with varied degrees of potency were described. The enthusiasm was high. Here at last was a method for getting at the problem. It was generally believed that if enough carcinogens were found, some characteristic common to all would establish a clue concerning the mechanism of their action. However, each time a likely theory was proposed, a new chemical would be described with carcinogenic properties which did not fit the theory. A theory that fits all the facts is still being sought. Thus, early in the forties there was a shift in the emphasis of research. The search for new carcinogens subsided and efforts to explain the mechanism of the existing chemicals were initiated."

APPOINTMENT of Dr. Russell M. Wilder, internationally known medical scientist, as Director of the recently established National Institute of Arthritis and Metabolic Diseases of the Public Health Service, was announced by Federal Security Administrator Oscar R. Ewing. Dr. Floyd S. Daft assumes the post of Associate Director of the new Institute. Formation of the new Institute, as part of the National Institutes of Health, Bethesda, Md., was recently authorized by Congress to intensify basic research in arthritis, rheumatism and such metabolic diseases as diabetes, goiter, peptic ulcer and certain forms of anemia.

(*continued on page 30*)

The Surgeon's Mart

When you are in need of surgical instruments or medical supplies you will find the dealers and manufacturers listed below ready to serve you. For your guidance when purchasing supplies we submit this list.

YOUNG'S DILATORS

Extremely useful in the treatment and prevention of contracted anus (particularly following hemorrhoidectomy), as an aid in perineal dissection and repair following delivery.

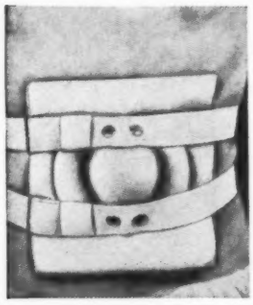
Sold only on prescription—at your surgical dealer or ethical pharmacy

Adult Set sizes 1, 1½, 2, 3—for stretching anal sphincter.
Children's Set sizes 0, 1, 1½, 2—for preventing contracted anus.
Size 3 and 4 drilled to take towel clamps—for use in perineal repair.

Write for Literature and Reprints

F. E. YOUNG & CO. 460 East 75th Street Chicago 19, Illinois

THE TRASK COLOSTOMY DOME, the appliance that uses the 33 ply cellucotton disposable receiving pad. A new fresh pad after each movement keeps the patient immaculate at all times.



NOTHING TO WASH

Sold at all leading surgical supply houses..... $10.50

If your dealer cannot supply your patients, order direct but be sure to mention your dealer's name.

THE TRASK LABORATORIES
BOX 52. Newtonville, Mass.

"Pressoplast"

Natural or Flesh Colored
Adhesive Cotton E-L-A-S-T-I-C Bandage
"Contura"—BANDAGE
skin protecting medicated
Write for Literature and Reprints

MFRS. OF ELASTIC BANDAGES AND DRESSINGS

Medical Fabrics Co., Inc.
10 Mill Street Paterson 1, N. J.

RADIUM
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SEEDS — APPLICATORS

THE RADIUM EMANATION CORP.
GRAYBAR BUILDING, NEW YORK 17, N. Y.
MURRAY HILL 3-8636

SPONGE BIOPSY FOR CANCER DIAGNOSIS

(Method of Dr. S. A. Gladstone)

Sponge Biopsy is simple, rapid, painless, reliable. Sponge Biopsy facilitates diagnosis in the early curable stage of cancer of the cervix uteri,* rectum, oral cavity, skin, etc. Sponge Biopsy has received awards at the Scientific Exhibits of the N. Y. State Medical Society and the American Medical Association.

For best results use Onkosponge No. 1 and Gladstone Sponge Biopsy Forceps, prepared and designed especially for Sponge Biopsy.

Write for descriptive leaflet and reprints.

* Ref. Am. J. Surg., March, 1951.
J.A.M.A. April 21, 1951 p. 1238

HISTOMED, INC.
181 Lafayette Street Paterson 1, New Jersey

FRACTURE EQUIPMENT

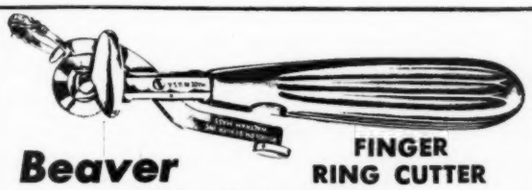
Ask your Dealer to show you RAJOWALT fracture equipment catalog

It will save you money

IMMEDIATE DELIVERY

Sold only through Surgical Dealers

RAJOWALT COMPANY
WARSAW, INDIANA



Beaver **FINGER RING CUTTER**

Removes Ring in 4 Seconds

Failure to get a ring off in a hurry can lead to tragic results. Every first aid room needs this inexpensive, easy to use instrument. Just slip lever under ring and turn thumb screw. Ring is cleanly cut in 4 seconds. Extra saws, always in stock, are 85¢.

Price $9.00 Complete

Rudolph Beaver Co. **Waltham 54, Mass.**

STRYKER Portable Suspension Traction Frame

For fractures of the femur in infants and children. Designed for Bryant traction and to simplify reduction. Fully adjustable for children up to seven years. Child can be taken home several weeks earlier.

ORTHOPEDIC FRAME COMPANY
Kalamazoo, Michigan

Outside the Ivory Tower

(*continued from page 28*)

A REVOLUTIONARY simplification of the problem of applying local moist heat, the Hydrocollator Steam Pack, completely eliminates onerous wringing, dripping and need for repeated applications. The specially processed silicate gel filler of the Steam Pack drinks up hot water and holds it to give at least thirty minutes of effective moist heat with each application. The Steam Packs are used over and over. Fully automatic, the Hydrocollator Master Unit maintains a supply of Steam Packs in water at the proper temperature—constantly ready for immediate application.

The Steam Pack is A. M. A. accepted and the Master Units are U.L. approved. Extensive clinical tests and evaluation have been completed by the Army and Navy. The Units and Steam Packs are in use in leading clinics and hospitals. The manufacturers are the Chattanooga Pharmacal Co., Inc., Chattanooga, Tenn.

BECAUSE of the grave international situation a greatly intensified medical research program to develop more effective means for collecting, preserving and using blood and its fractions and more knowledge of the medical value of the various components of blood has been launched by the Federal Government and a number of medical schools and other non-Federal institutions, Federal Security Administrator Oscar R. Ewing announced. As a result of agreements among the several agencies concerned with the National Blood Program, the National Institutes of Health, research branch of the Public Health Service has initiated the research and development phase of the intensified blood program, Mr. Ewing said. The various organizations concerned include the American National Red Cross, the National Research Council, the Federal Civil Defense Administration, the Department of Agriculture, the Department of Defense, the National Bureau of Standards, various independent blood banks and state agencies.

FROM The News Bureau, The Travelers, Hartford, Connecticut:

Last year 35,500 Americans were killed in traffic accidents. In 1950 1,799,800 Americans were injured in traffic accidents. There were 235,800 more persons injured in U. S. motor vehicle accidents last year than in 1949. Speeding on U.S. streets and highways last year killed 13,300 men, women and children. Speeding on U.S. streets and highways last year injured 475,500 men, women and children. In 1950 9,400 pedestrians were killed in the United States. Last year, 299,500 pedestrians were injured in the United States. Twenty-four per cent of all drivers involved in fatal automobile accidents in the U.S. last year were between the ages of eighteen and twenty-four. Ninety-eight per cent of drivers involved in fatal automobile accidents in the U.S. last year had at least one year's driving experience.

Male drivers in 1950 were involved in more than 90 per cent of all U.S. automobile accidents. Three of four traffic accidents happen in clear weather on dry roads. About 75 per cent of last year's automobile accidents involved passenger cars. More than 80 per cent of all accidents last year on our streets and highways involved vehicles going straight. An overwhelming majority of motor vehicles involved in accidents last year were reported in apparently good condition. Fifty-seven per cent of last year's fatal accidents occurred during hours of darkness. Forty-two per cent of last year's motor vehicle accidents involving injuries happened in the dark.

Saturday and Sunday remain the most dangerous days of the week in traffic. You are almost three times as likely to be killed in an automobile accident between seven and eight in the evening as you are between seven and eight in the morning. (*continued on page 38*)

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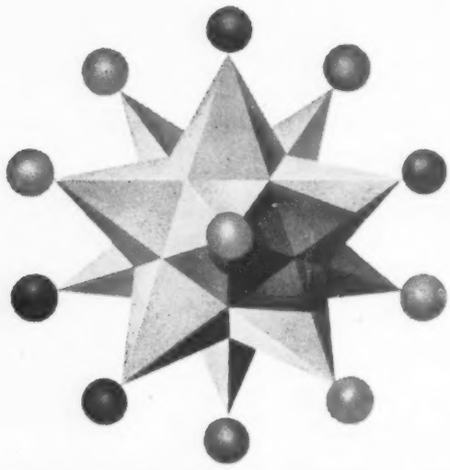

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Sixtieth Year of Publication

VOL. LXXXII JULY, 1951 NUMBER ONE

Editorial

SIXTIETH ANNIVERSARY

SIXTY years ago (July, 1891) the first number of the then American Journal of Surgery and Gynecology was published in Kansas City, Missouri. Several years later the present name of the Journal was adopted. It has been published continuously as a monthly ever since, except for a short time in 1898 when it was a weekly. We read that by 1893 it had a circulation of 5,000, and we cannot help but wonder how much of this was dead wood and not paid for. The subscription price was "One dollar per annum—*Payable at the end of the year if preferred.*" Evidently many took advantage of this generous offer and forgot to part with the dollar when due, because somewhat later the subscription rate became fifty cents but strictly "payable in advance." This price held for all "citizens of the United States outside of Kansas." For some unaccountable reason foreigners and Kansans were charged a dollar. In Volume v we read that the Journal was a "clean, bright, newsy paper full of interesting news and medical literature."

The Journal has had three editors. The first was Emory Lanphear, M.A., M.D., PH.D., LL.D., who served from 1891 to 1905. He was succeeded by Dr. Walter Brickner, an able gentleman, who guided the publication from 1905 to 1928.

At that time (1928) we began to occupy the "chair." During the twenty-three years we have conducted the Journal we have seen a great evolution in medicine and surgery. It is a far cry from 1891 when, as you will note in the photographs and prints of operating rooms and their personnel, surgeons did their work without masks, caps or gloves; the anesthetist merely doffed his coat, rolled up his sleeves and *poured* ether or chloroform on a closed or open mask. Even when we were a medical student (circa 1905) we sat in the operating amphitheatre and watched the old boys scrub their arms and hands and, wearing sterile gowns, enter the operating room, wipe their glasses, demonstrate something on a blackboard, fondle their mustaschios or beards and then proceed with the operation.

When this Journal was founded, surgery was in its cradle stage and medical education had many defects. Today, the population of our country is two and a half times what it was about the time of The World Fair in Chicago (1892). People lived in houses and not in one and a half room apartments with the beds buried in the side wall. Electrical illumination was in an embryonic state; people used oil lamps. In the larger cities many had illuminating gas; and when the Welsback gas mantle went on sale, it was declared that the ultimate in lighting had arrived. Outside of the large towns and cities the dirt roads were well nigh impassable during certain times of the year. (The Tin Lizzie corrected this fault.) Eggs cost ten cents a dozen, coal was four dollars a ton, a

regal steak dinner could be had for seventy-five cents to a dollar, and a man was considered rich and ripe for retirement when he had accumulated about a hundred thousand dollars. My father (M.D., Harvard '68) paid twenty-five dollars a month to board and feed his horse. A medical student paid a tuition fee of one hundred to one hundred twenty-five dollars a year. Some medical schools still had a two-year course but the great majority had advanced to three years. Many medical schools were fly-by-night diploma mills. They were conducted only to make a profit. The greater the profit the more successful the academic year. Abraham Flexner did away with all that. Following his report and recommendations all these tenth rate schools folded up and were no more. A new era in medical education had begun.

We have no intention of going into details concerning all the changes and advances that have been made in medical education, hospital training and the various branches of surgery during the past half century. It has been done innumerable times. But after Flexner changed the medical scene medical standards took a decidedly favorable turn. A three hundred bed hospital could no longer be manned by two to four interns. About 1910 the residency system began in earnest. Three years later the American College of Surgeons had its first meeting. In time, minimum hospital standards were adopted and a hospital of any note conformed to the requirements in order to earn the seal of acceptance.

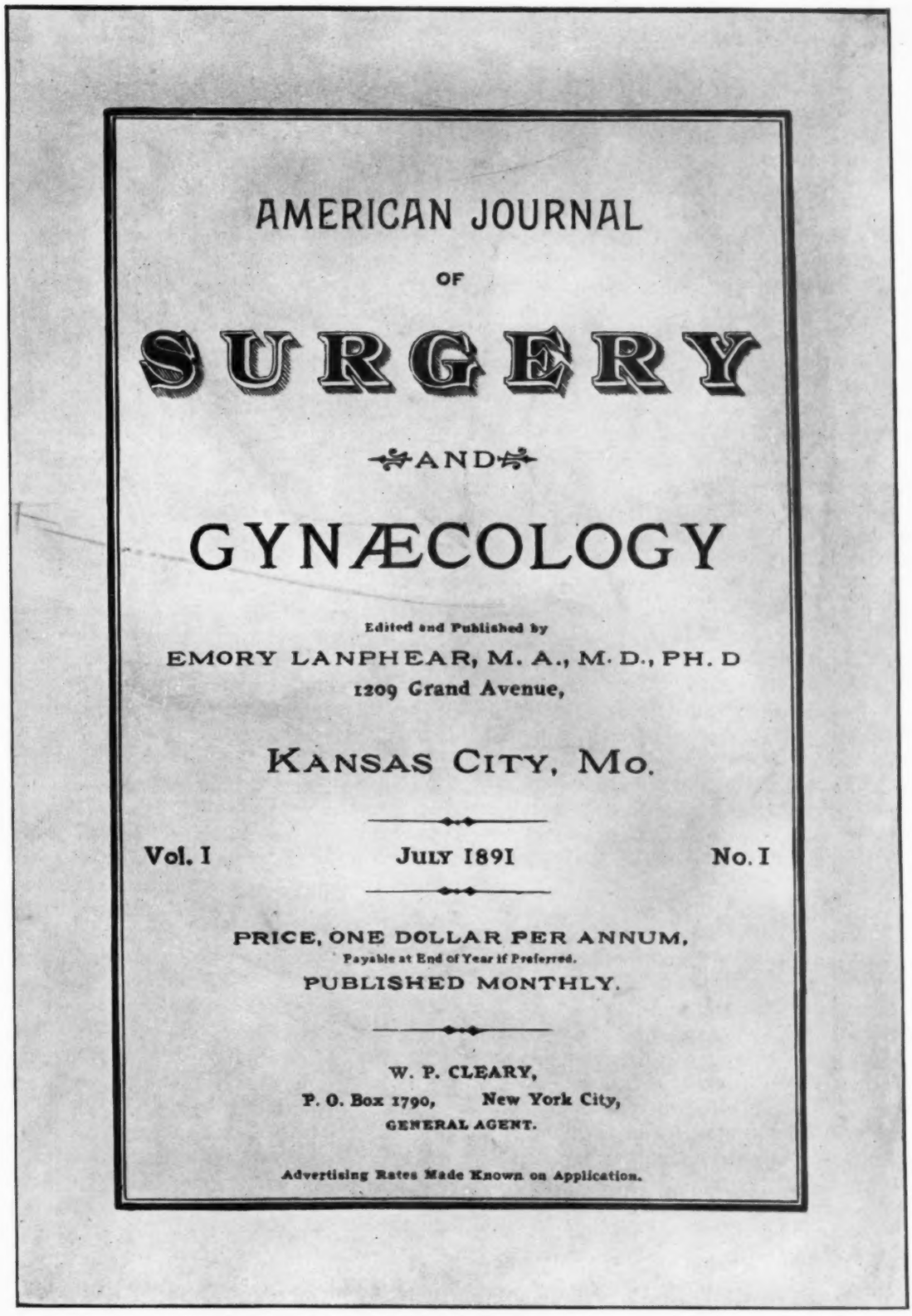
There was a time when a man, who had developed a large practice or became tired of making the endless rounds, would awake one morning and decide he was a specialist. The specialty usually depended upon the majority of ailments the doctor saw in his daily work. If he did a lot of "confinement cases" he was an obstetrician; if nose and tonsil infections, he became an E.N.T. specialist, etc. Later on this also changed. Speciality Boards were set up and minimum requirements were outlined. As a result, a man today who has met the requirements and passes his examinations is truly trained to carry on in his chosen field. The new intern no longer is handed a mask and a can of ether and told to learn the art of "putting the patient under." Physicians today are trained in anesthesiology and must pass their Board examinations.

Other specialties have come to the fore. Pathology has become a most important department. Today a hospital must have a well equipped patholgic laboratory headed by those specially trained in this work. Hospital departments conduct weekly or monthly staff conferences. Many hospitals now have their own blood banks and schools of nursing. During the past quarter of a century roentgenology has jumped from merely "taking pictures" to a science. A lot of scientific water and its by-products have gone under the medical bridge in the past sixty years.

In 1929, Arnold Jackson attended a meeting of the College of Surgeons in Boston where he had witnessed several operations performed under spinal anesthesia. A new and "safe" preparation had been used. Here and there were surgeons who employed spinal anesthesia, but the hazards were great and the vast majority of surgeons would have no part of it. Jackson, who stopped in our editorial office on his way home, believed this safer method would be revolutionary. Accordingly, we immediately contacted the few men we knew had experience with this method and in two months' time the Journal published a number devoted solely to Spinal Anesthesia. As a result, close to 3,000 new subscribers were entered on our books, and this Special Number was purchased by as many more physicians. It was a turning point in the Journal's career. From then on the Journal grew by leaps and bounds. We started to publish 200 text pages; special issues often exceeded 350 pages. New departments were initiated. Monographs were published in installments and then brought out in book form. Numbers devoted to the various surgical specialities were done under the supervision of Guest Editors. Circulation grew. We saw to it that all advertising was clean and reliable. Ours was a quality journal, and has continued to be a quality journal of the first order. Keep in mind the Journal is an independent publication not owned or run by a society, clique or surgical association.

Many of the country's outstanding surgeons have been on our Editorial Board. Some of these gentlemen who were on the Board when we became editor in 1928 are still with us: James T. Case, Donald Guthrie, A. V. S. Lambert, Urban Maes, Roy D. McClure,* Rudolph

*Shortly after this was written Dr. McClure died suddenly (March 31, 1951). An outstanding surgeon; a true friend.



THE FIRST COVER OF THE AMERICAN JOURNAL OF SURGERY

Matas and Hubert A. Royster. Some of our Board members have passed away. Many became friends. They were never too busy to pause and listen to our problems and to advise us. We cannot name all of them but we do miss them. We had luncheon with Robert C. Coffey, of Portland, Oregon, a week before he met his death in a plane accident. At another time we were selected to meet John Deaver at the Pennsylvania Station and conduct him to a meeting. We spied a gentleman in a pearl grey fedora, a gay striped shirt and stiff collar; his mustaschio was waxed at the ends; he wore a jaunty topcoat and twirled a pair of pale yellow gloves. We introduced ourself. "My boy," he cried, "how did you know it was *ME?*" W. B. Coley, father of Bradley L. Coley, Associate Editor, was a frequent, instructive and entertaining visitor. Arthur E. Hertzler did a great deal for us. Once we wrote asking him for an editorial. Within the space of a week he sent us five editorials. He must have worked around the clock. We were selected to play host to Hugh Young and entertain him for an afternoon prior to a meeting. We saw "Wings," the first moving picture dealing with airplanes in combat. It was a sob picture, and Young cried until the last flicker. The picture over, a handkerchief to his eyes, he said, "I love to cry, don't you?" We wish we could publish his off-the-record consultations at the bedside of President Woodrow Wilson and that of Mrs. Harding. Howard A. Kelly, George Crile, J. D. Polak and Elliott C. Cutler were invaluable. All of them gentlemen of parts, possessed of personal magnetism, tireless, good companions; to have known them was never to forget them.

It is a publishing truism that the circulation department must be on the job 365 days in the year. Subscribers die and drop out. New subscribers must be procured and every effort made to keep them on the lists. A large percentage of our subscribers have been with us a long, long time. Our circulation is not static; every year shows an increase. Being curious, we asked the head of the circulation department if we could quickly get a list of a few subscribers who have been with us for a long time. This is the result: Dr. Pablo J. Munoa of Salto, Uruguay (1915); Dr. J. W. Kennedy of Junction City, Kansas (1910); Dr. James W. Jameson of Concord, New Hampshire, (1921); Dr. George H. Bunch of Columbia, South Carolina (1922).

In 1941 we published our Fiftieth Anniversary Number. Then the medical and surgical scene of these fifty years was covered by men of national prominence. We became involved in a European war and now we are engaged in an "incidence" on the other side of the globe (over 10,000 of our boys killed). What the future has in store for us no man can prophesy. But during the past ten years medical science has forged ahead with unheard of speed. It would gain us nothing to enumerate all the discoveries and advances accomplished in these years; consider the newer chemotherapeutic drugs, the antibiotics, the forward strides made in diagnosis and treatment in neurosurgery, pulmonary surgery, gynecology, vascular and heart surgery, ophthalmologic surgery, plastic surgery, orthopedic surgery, rehabilitation surgery and all the other branches of the healing art and science. We have lived through a new era. We are on the threshold of still newer and more astounding accomplishments. With all the present turmoil, sorrow, unrest and fear, we are still living in a wonderful age.

In reality a Sixtieth Anniversary is like an off-year election. We were on the scene at our Fiftieth Anniversary, but we doubt if we'll play much of a part in our next gala celebration, the Seventy-fifth Anniversary. We may possibly be around; but although we were quite young when we made our Journal bow, fifteen years from now we'll be among the real elder statesmen. However, we hope most of those who read these lines will be here (1966) in all their vigor and mental keeness.

All of the contributors of this special issue are from our Editorial Board. We had hoped everyone would be able to contribute. We were, in truth, surprised that such a large percentage did contribute. Some of our Board members were ill; some had so many commitments it was impossible to put another straw on their scientific back. Dr. Matas, now past ninety years, wanted to prepare an article, but his days are full and we did not insist. However, we thought it would be a nice gesture to republish his article written for our Fiftieth Anniversary Number. Those who have not read it have a treat in store for them. We believe you'll find every contribution more than worth while. In fact we have found every article of such equal importance that we have not arranged the material according to subject matter but alphabetically according to the author's name. We

cannot thank our editors enough for the pains they've taken and the work they've done in order to carry a thought or an idea through to the printed page.

We acknowledge a deep sense of gratitude to our Editorial Board for their help and suggestions over the years, and to the Publishers who have given us a free hand and constant encouragement, also to our intimate professional editorial staff who have made our burdens a pleasure. To all of these and to you, our subscribers, renewed assurances of our highest consideration, and sincere wishes for future days of peace and contentment.

T. S. W.

Original Articles

LOCAL RECURRENCE FOLLOWING SUBTOTAL GASTRECTOMY FOR CARCINOMA*

CLARENCE J. BERNE, M.D. AND MARSHALL A. FREEDMAN, M.D.
Los Angeles, California

THE detection of operable gastric carcinoma at laparotomy places upon the surgeon the responsibility of performing a resection comprehensively designed to give the patient the maximum likelihood of cure. The extent of this resection must be oncologically correct if the disease is to be eradicated. Gastric carcinoma manifests great variation in the degree of spread present at the time of surgery. A small gastric carcinoma may have metastasized widely and, conversely, a large lesion may exist with minimal spread. Between these extremes rest the majority of instances in which the primary lesion is sizable and some degree of spread has occurred. When "resection for cure" is found to be warranted, the operative procedure involves two phases of potentially existing dissemination, mural and lymphatic. General agreement exists that such a resection must include *en bloc* removal of the greater omentum and regional lymph nodes and considerable duodenum with the gastric segment. The correct amount of stomach to be removed has not been precisely defined and it is this phase of the problem with which our report is concerned.

Castleman's[1] studies demonstrating duodenal invasion by gastric carcinoma have placed the minimal *distal* level of resection at 3 cm. beyond the pylorus when subtotal or total gastrectomy is to be performed. This has been corroborated by Coller et al.,[2] Fodden,[3] and Zinninger and Collins,[4] all of whom found frequent transpyloric intramural invasion of the duodenum. No comparable published studies exist relative to the distal level in the operation of cardio-esophagectomy for carcinoma of the cardia.

Concepts regarding the proper *proximal* level of resection for gastric carcinoma are undergoing revision. In carcinoma of the cardia Brownson[5] found microscopic invasion of the esophagus in twenty-six of twenty-seven resected specimens. In "discrete gastric carcinoma" Verbrugghen reported microscopic intramural extension beyond the grossly palpable tumor margin for distances up to 3.5 cm. along the lesser curvature toward the cardia. He advocated removal of at least 4 cm. of grossly uninvolved stomach for carcinomas with definite margins but could indicate no proper point for resection in "diffuse carcinomas." The work of Zinninger and Collins, and Coller et al. indicated that in 17.2 to 24.5 per cent of resection specimens the upper line of resection had been through gastric wall containing carcinoma. Recently Longmire[7] has advocated the routine performance of total gastrectomy for all gastric carcinomas thus automatically shifting the proximal level of resection to the esophagus.

Further evidence to help in establishing the proper upper level of resection is desirable. If any form of gastrectomy is performed for gastric carcinoma, the surgical pathologist should, ideally, accurately determine the amount of normal gastric margin resected proximal and distal to the neoplasm. These findings should be reported by him before the anastomosis is started. However, this determination is subject to a high degree of error first because gastric tissue shrinks rapidly and a 3 cm. margin, as estimated by the surgeon's palpation, may be measured as 1 or 1.5 cm. in the laboratory. Second, it is difficult to obtain satisfactory fresh frozen sections of

* From the Departments of Surgery and Pathology, the University of Southern California School of Medicine and the Los Angeles County Hospital, Los Angeles, Calif.

gastrointestinal tissue because of the mucus content of the mucosa and the loose arrangement of the submucosa which permits the mucous membrane to twist in any direction from the remainder of the wall. Third, although the well differentiated types of carcinoma are easily recognized microscopically, the more anaplastic carcinomas may be composed of small cells so closely resembling lymphocytes that the extent of mural spread may be impossible to determine by the frozen section technic. Local recurrence may therefore take place even though microscopic examination at the time of surgery had indicated that the margins were free of neoplastic cells.

TABLE I
LOCATION OF CARCINOMA AT AUTOPSY

	Cases	Per cent
No carcinoma present	2	7.1
Local recurrence only*	0	0.0
Metastasis only	3	10.7
Local recurrence and metastasis	23	82.2
Total	28	100.0

* Refers only to recurrence in gastric and/or duodenal stump.

We have studied the autopsy protocols of patients who survived a significant period of time following subtotal gastrectomy for carcinoma and wish to report the findings at the upper and lower levels of resection. The presence of carcinoma at these sites constitutes irrefutable evidence of inadequacy of the surgical procedure and represents a true biologic test.

At the Los Angeles County Hospital from July 1, 1938, to July 1, 1949, 21,305 necropsies were performed and 425 cases of gastric carcinoma were found. Among these were fifty-four patients upon whom a curative type of resection, total or subtotal, had been performed. There were forty-six patients who had had their carcinoma treated with subtotal gastrectomy, exclusive of those in whom the operation had been considered palliative. Twenty-eight of these patients who had had subtotal gastrectomy and had survived more than a month represent the basis for this report.

Analysis of these twenty-eight cases is presented in Tables I and II. Table I is submitted to indicate the relative distribution of the carcinoma at the time of autopsy, referring only to whether it was local or disseminated in order to provide a basis for orientation in regard to the data presented in Table II. The two cases listed as "no carcinoma present" represented death from other causes. Table II is designed to indicate the adequacy of the previous gastrectomy as regards the upper and lower level of transection through the stomach and duodenum, respectively. Presumably, from what is known about mural spread of gastric carcinoma, nearly all of these recurrences represent involvement of the wall as the result of direct mural extension in continuity from the primary tumor. It is not possible to exclude operative implantation, mural metastases or multicentric primary neoplasms, but the implications would largely be the same. In evaluating Table II accurate data were available regarding the location and size of the primary tumor in most of the cases. In 75 per cent it was pyloric (antral) and in 41.4 per cent it was 5 cm. or less in its greatest dimension. Under these conditions 78.6 per cent of the autopsied cases showed carcinoma in the gastric stump and 10.7 per cent showed a similar finding in the duodenal stump.

TABLE II
SITES OF LOCAL RECURRENCE AT AUTOPSY*

	Cases	Per cent of Twenty-eight Cases
Gastric stump	22	78.6
Duodenal stump	3	10.7

* Two of the twenty-three patients with local recurrence had involvement at both gastric and duodenal stumps.

COMMENTS

In evaluating these statistics consideration should be given to the fact that where metastases were found in the presence of stump recurrence the latter may have given rise to the metastases in certain cases. Therefore, metastases in the presence of local recurrence are fundamentally of secondary importance. Primary importance should be given to the fact that when stump recurrence exists part of the primary tumor must be presumed to have been left *in situ* at the time of surgery. Therefore, regardless of any other factor approxi-

mately three-quarters of the patients in this group were doomed when they left the operating room because a controllable factor, the amount of stomach removed, was inadequate. The basis for this consistent error on the part of surgeons can only be a misconception regarding the amount of clinically undetectable mural spread in gastric carcinoma. That this error is not restricted to our geographic area is indicated by the fact that a significant number of the procedures were performed elsewhere and by surgeons trained at many of the surgical centers in the United States. Substantiation of our belief that this stump recurrence rate cannot be dismissed as indicating particularly inadequate gastric resections at our hospital has been provided by Guiss.[8] His material includes a five-year follow-up on sixty-one survivors of gastric "resection for cure." There were 31.4 per cent alive and free of their disease at the end of five years ("5-year survivors") and 23.5 per cent lived five years or longer, remaining free of disease subsequently ("5-year cures"). Guiss' survey included all cases of gastric carcinoma over a twenty-year period of time and 97 per cent of the cases were followed up successfully.

CONCLUSIONS

When operable carcinoma of the gastric *cardia* exists, present evidence indicates the absolute need for inclusion of a significant segment of esophagus with the stomach, more than can be removed with abdominal surgery alone. In these cases the ideal proximal and distal level of resection is not yet well defined by studies comparable to those indicated in our report. In operable carcinoma located distal to the cardial portion of the stomach the situation also is not clear. For carcinoma of the *body* of the stomach total gastrectomy with splenectomy should usually be performed. If carcinoma involves the distal half of the stomach, the situation is inherently more susceptible of local cure, but the surgeon tends to be more conservative in the upper level of gastric transection. Our evidence indicates the need for a much more extensive removal of stomach and duodenum, especially stomach, than has been generally practiced in this group. An early stage of the disease and a low degree of malignancy may justify less than total gastrectomy in some cases of antral carcinoma, particularly in view of the physiologic factors favoring the retention of at least a small gastric pouch. When such exceptions are made, the resection must be a very radical subtotal gastrectomy with at least a 3 cm. duodenectomy in continuity. In the pathologic study of surgical specimens all gastric surgeons should insist on a report of the extent of disease in the specimen in addition to the usual primary diagnosis. The extent of disease should be reported in relation to the levels of resection and the latter should be carefully recorded. Significant potentialities exist from increased cooperation of the pathologist at the time of operation. Such studies will provide an accurate record of the surgical "margin" in relation to the pathologist's findings, to be correlated later with the evidence of local recurrence in patients coming to necropsy.

SUMMARY

Necropsy study of twenty-eight patients who survived subtotal gastrectomy for gastric carcinoma disclosed a "recurrence" rate of 78.6 per cent in the gastric stump and 10.7 per cent in the duodenal stump. The usual subtotal gastrectomy frequently fails to accomplish a complete removal of the primary tumor because an inadequate amount of stomach is removed.

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UNDESCENDED TESTICLE AND HYPOSPADIAS

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UNDESCENDED testis and hypospadias are two common genital tract malformations observed in young boys and are discussed here not only as clinical problems but also more particularly from the therapeutic aspect: what to do and when.

Imperfectly descended testis, commonly designated as cryptorchism, is present at birth in about 3 per cent of all boys but by puberty the incidence becomes approximately 1 per cent. In other words, descent occurs in two of three cases by puberty. When normal descent has not occurred by puberty, subsequent descent is most unlikely. Either side may be involved and in about 10 per cent the anomaly is bilateral.

The etiology of cryptorchism is indefinite since no one explanation fits all cases. Abnormalities such as an unusually long mesorchium (testicular mesentery) commonly exist and are adduced to explain the failure of the organ to engage in the internal inguinal ring and to complete its descent. Other conditions offered in explanation of the anomaly included (1) mesorchial-peritoneal adhesions, (2) an abnormal persistence of the plica vascularis anchoring the testicle high, (3) short spermatic vessels or vas deferens, (4) absent, unusually long or inactive gubernaculum, (5) cremasteric hyperactivity interfering with descent, (6) maldevelopment of the inguinal canal, (7) scrotal maldevelopment with absence of the testicular cavity or, finally, (8) a testicle of greater size than the inguinal canal. The important consideration is that the testicle does not reach its normal position in the depth of the scrotum. Moore has conclusively shown that physiologically the scrotum functions as a testicular radiator and in its cooler confines normal growth and development of the testes and maturation of spermatogenesis occur. The abdominally retained organ fails to develop normally not only in size but also from the spermatogenic aspect. (Fig. 1.) Ninety per cent of males with bilateral abdominal testes after puberty are sterile. It is chiefly to prevent sterility of the maldescended testicle that treatment should be instituted earlier than commonly recommended. Pediatric literature in particular has largely advocated delay of the surgical treatment of cryptorchism until after puberty but by this time the hope and opportunity of preserving spermatogenesis is generally lost. Moreover, strangulated hernia or torsion of the spermatic cord may intervene as I have observed in some unfortunate cases.

In some instances the testicle migrates ectopic to appear (1) interstitial anterior to the aponeurosis of the external oblique muscle, (2) in the femoral or crural area, (3) at the base of the penis, (4) in the perineum as we have observed in four cases or (5) both testes may descend through the same inguinal canal and one shows transverse ectopy. (Fig. 2.) The usual maldescent is in the abdominal or inguinal location.

Congenital inguinal hernia accompanies 80 to 90 per cent of imperfectly descended testes, merits grave consideration in the surgical therapy, and when present calls for operative treatment rather than prolonged administration of hormones. The vas deferens is usually of normal length but the vessels of the spermatic cord are frequently shorter than normal. Although the incidence of malignant growth of the imperfectly descended testicle is said to be twenty-two times that of the normally placed organ, the actual occurrence of such growths is relatively so infrequent as to merit no consideration *per se* as a surgical indication for orchiopexy. Moreover, the testicle previously ectopic but surgically placed in the scrotum may become neoplastic.

The diagnosis of cryptorchism is readily made by palpation; and when the testicle is not present in the scrotum, examination of the perineum and adjacent structures for an ectopic testicle must not be overlooked. In cases of ectopic testicle inadequately examined the organ is thought to be abdominal. In making the local examination it is imperative to determine whether congenital hernia exists and, if present, its nature, type and degree. In one boy who had been subjected to pro-

longed and expensive hormonal therapy two fingers could be introduced through the hernial hiatus into the abdominal cavity.

In contemplating treatment in these cases the preservation or improvement of the testicular function is the important consideration. Unfortunately, most physicians do not adequately appreciate this point and undue delay in correction of the testicular position is advised. By the administration of A.P.L. hormone (chorionic gonadotropin, anterior pituitary-like hormone of pregnancy urine) the probability of descent at puberty can be anticipated even in infancy. This should be determined comparatively early.

In bilateral cryptorchism therapy should be undertaken by the third year and in unilateral cryptorchism by the fifth or sixth year.

If congenital hernia is demonstrable at the time of the initial examination, the treatment is patently surgical from the start and with pronounced hernia, much earlier than the three- and five-year age for bilateral and unilateral lesions, respectively. A truss should never be permitted in cryptorchism with hernia because of the likely injury of the testicle by direct pressure and/or by ischemia resulting from compression of the spermatic cord. The administration of a small amount of A.P.L. substance for ten days preoperatively frequently renders the orchiopexy technically simpler because of enlargement and engorgement of the structures it induces and which facilitates intravascular dissection for the elongation of the spermatic cord.

When there is no demonstrable hernia, A.P.L. substance should be administered in doses of 100 to 200 rat units twice a week according to the age and size of the boy; a five year old is given 150 to 200 rat units twice weekly. If satisfactory results are not achieved by the administration of 2,500 units, operate. Although descent may follow administration of the hormones, not infrequently following cessation of therapy the testicle withdraws to its former position. Operation is indicated.

In the surgical treatment our preference is the Torek procedure or one of its modifications. When the cord is short, we bring the testicle down and fasten it through the scrotal window to the upper inner thigh. (Figs. 3 and 4.) When the cord is comfortably long and permits the testicle to be brought down readily to the deep scrotum, we usually anchor the

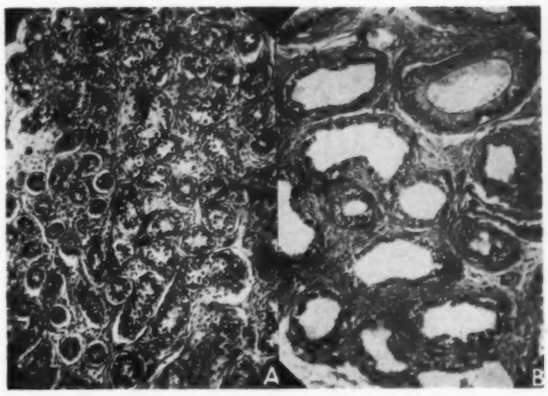

FIG. 1. Imperfect descent of the testes. Histology, A, normal properly descended testicle in a ten year old boy showing the rich cellular structure with abundance of tubules and relatively scant interstitial tissues. B, maldescended testicle retained in the inguinal canal in a ten year old boy. There is pronounced increase in interstitial tissue with severe tubular degeneration; unquestionably, such a testicle would be sterile after puberty.

organ down by sutures fastened to the inner thigh through an intermediary rubber band. (Fig. 4K.) This maintains mild traction on the organ for four or five days by which time firm fibrinous adhesions will have formed between testis and scrotum.

Ectopic testicles should be implanted in their normal site in the scrotum; in these cases the cord is usually sufficiently long to render extensive intravascular dissection unnecessary. If the testicle is anchored in the scrotum by the fifth or sixth year and is of approximately normal size, the prognosis for subsequent fertility is good. Most of these testes are smaller than normal or even diminutive at the time of operation; and when the blood supply has not been surgically injured or compressed, they show remarkable growth often to essentially normal size in one year. When emplacement in the scrotum is too long delayed, the gland may show no further atrophy but may simply fail to grow. While 90 per cent of testes bilaterally undescended at puberty are sterile, in bilateral cryptorchism properly operated on in early boyhood, MacCollum's studies showed 80 per cent were fertile. Such evidence strongly supports the dictum of early operation.

HYPOSPADIAS

Hypospadias is characterized by a congenital defect of the anterior urethra in which the canal terminates ventral and posterior to its normal opening in the glans penis. The anomaly

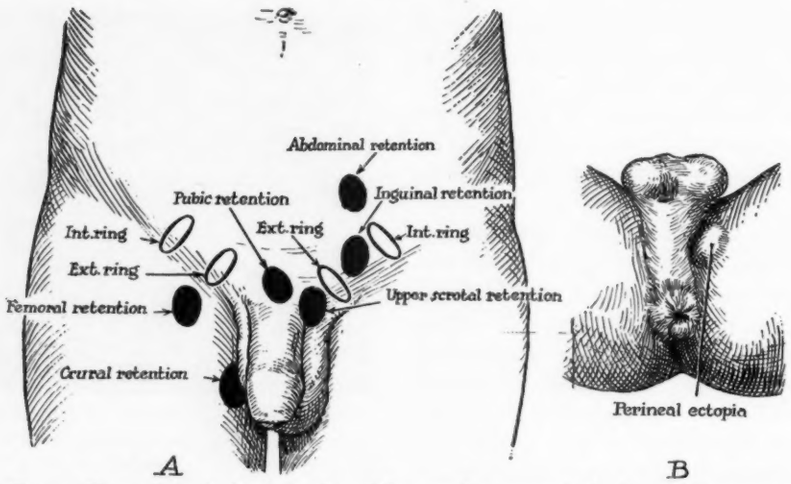

FIG. 2. Sites of testicular ectopia; while usually congenital, the malplacement may also result from trauma.

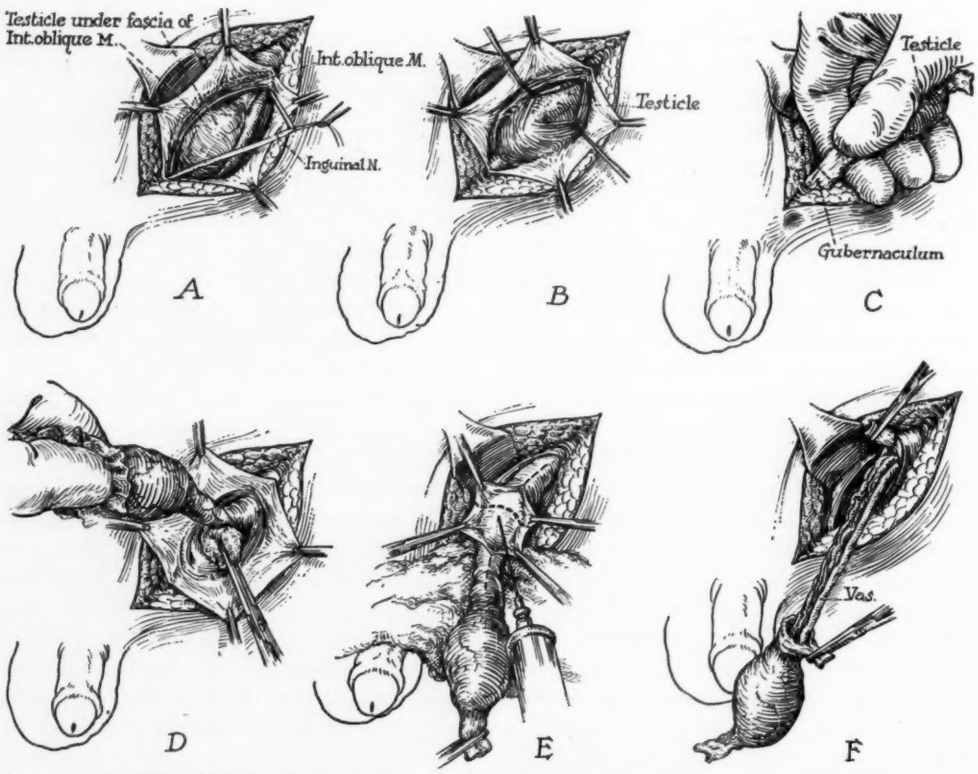

FIG. 3. Imperfect descent of the testicle; surgical treatment by the Torek procedure. Having exposed and delivered the testicle through an inguinal incision (A to D), the cord is exposed and lengthened by delicate intravascular dissection; C, division of the gubernaculum; D, by sharp and blunt dissection the spermatic cord is delivered from its sheath; E, injection of normal saline as advocated by some to facilitate intravascular dissection; F, dissection of the cord for elongation and separation of the vas deferens with high division and ligation of the congenital hernial sac found in at least four of five cases of cryptorchism (From Campbell, M. Clinical Pediatric Urology. Philadelphia, 1951, W. B. Saunders Co.)

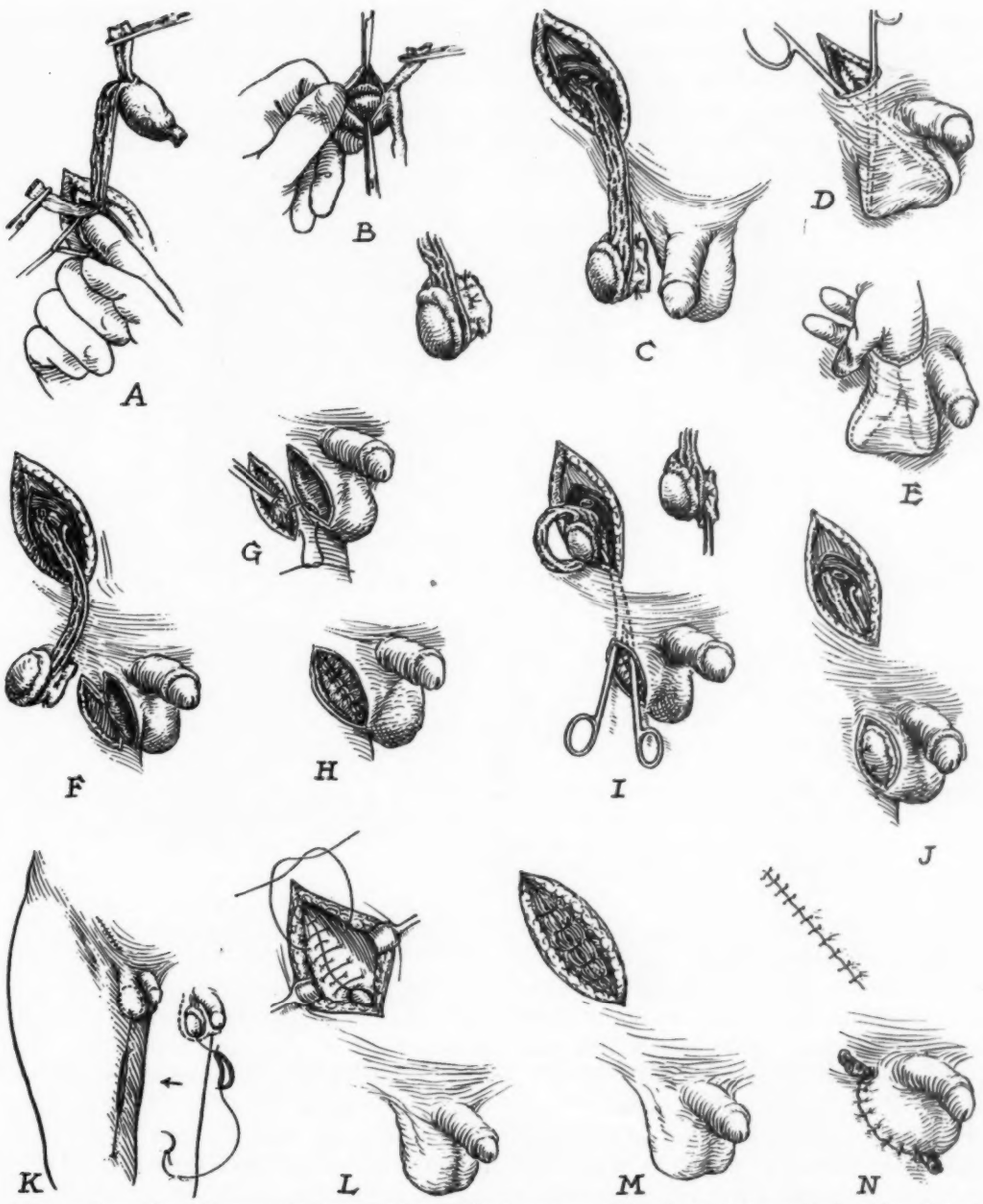

FIG. 4. Imperfect descent of the testicle; surgical treatment by the Torek method. A, hernial sac ready to be tied off; by blunt finger dissection high in the inguinal canal many adhesions can be broken down to afford added lengthening of the spermatic cord by 1.0 to 1.5 cm. B, the tunica vaginalis is opened and its edges are sutured loosely behind the testicle to prevent the subsequent development of hydrocele. C, the cord which has been adequately lengthened by intravascular dissection of restraining fibrous adhesions is now ready to be brought down into the scrotum which has been prepared (D) by creation of a scrotal sac cavity by the fingers (E) and by wide division of the dartos fascia of the deep scrotum. F to J, through a lateral scrotal window the testicle is brought down and anchored by two or three fine silk sutures to the deep fascia of the adjacent upper inner thigh. K, an alternate method of temporary fixation of the testicle by means of an intermediary rubber band (Cabot). One suture anchoring the testicle is passed out through the lower pole of the scrotum and tied to the upper end of a small stationer's rubber band which at its other end is tied to a suture securely placed in the lower inner thigh. The tension or traction of this mechanism is only sufficient to keep the testicle in the lower scrotum. If too much traction is made, the suture will tear out from the testicle or from the thigh. L to N, closure of wounds as in herniotomy without transplantation of the cord. A small vaseline wick is placed in the space between the scrotum and the upper inner thigh. At any time after three months the testicle and scrotum are disjoined from the thigh; the gland may be expected to remain permanently in normal position. (From Campbell, M. Clinical Pediatric Urology. Philadelphia, 1951. W. B. Saunders Co.)

is classified according to its location as glandular or balanitic, penile, penoscrotal, bulbous, perineal or pseudovaginal. (Fig. 5.) The condition is observed in about 1 in 1,500 boys, the balanitic form being the most common and the incidence of the other forms being inversely

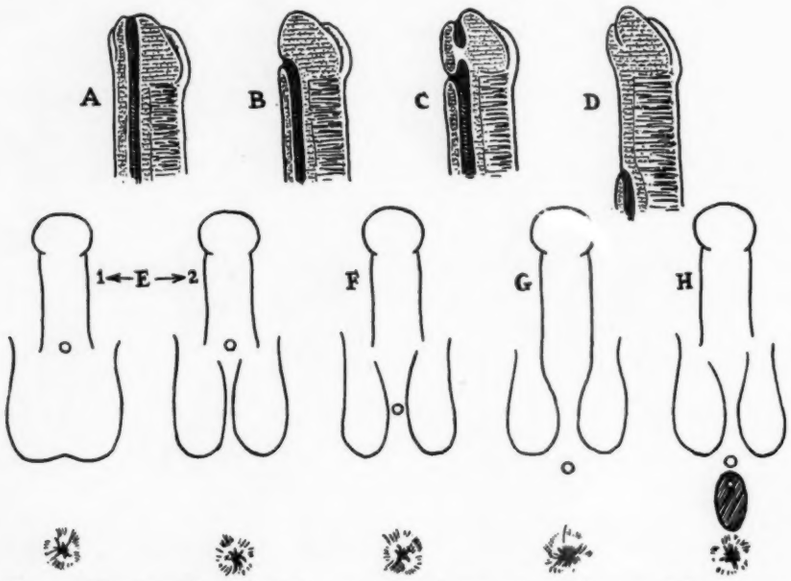

FIG. 5. Hypospadias. Varieties. A, normal meatal opening; B, balanitic; C, balanitic with false dimple in the glans penis; D, penile; E, penoscrotal without (1) and with (2) scrotal cleft; F, deep scrotal with bifurcated scrotum; G, perineal; divided scrotum; H, pseudovaginal.

relative to their severity. In the more pronounced forms of hypospadias the prostatic utricle is commonly abnormal, being enlarged, often in modified uterine formation, sometimes even showing fallopian tube-like extensions into the pelvis. Determination of the sex of the infant or child is frequently exceedingly difficult in pseudovaginal hypospadias and may even require laparotomy exploration. The true sex should be determined by the second year.

In the diagnostic study of these patients it is important to determine that no urethral obstruction exists; the integrity of the upper urinary tract may be demonstrated by satisfactory excretory urography. I routinely use intravenous urography in these cases because in about one in three patients with genital malformations the upper urinary tract is also anomalous. To illustrate, a severe yet asymptomatic congenital stricture of the body of the right ureter was thus accidently discovered in an eight month old boy with balanitic hypospadias. (Fig. 6.)

In the surgical approach to hypospadias the construction of a urethral canal which will make insemination possible is the primary objective; the second achievement is normal urination in the standing position. Cosmetic improvement is of psychologic but not of physiologic concern.

The initial therapeutic step in hypospadias is the correction of the usual complicating chordee which causes downward incurvation of the penis. The fibrous ventral G-string which produces the chordee represents the congenitally hypoplastic corpus spongiosum and exists as a dense band or scar extending from the region of the frenum posteriorly, frequently as far as the bifurcation of the penile corpora. (Figs. 7 and 8.)

In the initial treatment of hypospadias free urinary drainage must be present or be established if necessary by meatotomy, urethral dilation with sounds or urethrotomy. Balanitic hypospadias is best left alone other than to establish a wide open urethral meatus by meatotomy if needed and to ascertain that the remainder of the urinary tract is not obstructed. Attempts to pretty up the end of the penis in these cases is meddlesome surgery.

Penile and more severe forms of hypospadias demand such initial surgical correction of congenital chordee as seems indicated. (Figs. 7 and 8.) When this procedure has been done

FIG. 6. Congenital stricture of the right ureter discovered by routine excretory urography in an eight month old boy with tight balanitic hypospadias. Excretory urography should be a part of the examination of all patients with anomalous external genitalia; about one in three of these have maldevelopments of the upper urinary tract which are often of greater vital importance than the genital abnormality.

matter of considerable moment to the boy, particularly in his relationships with his companions and in his own psychologic outlook. It is often of even greater import to the parents whose unbridled concern commonly serves to focus all family interest on the boy's mal-

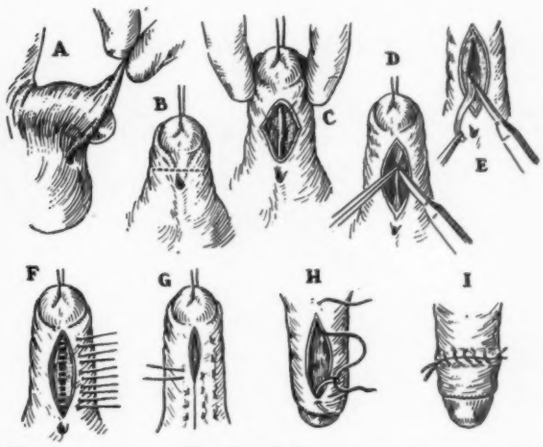

FIG. 7. Hypospadias. Surgical treatment. First stage operation to be performed by the end of the first year to correct congenital chordee by excision of the hypoplastic corpus spongiosum which forms the G-string producing the down bowing of the penis. Often this requires excision of the fibrous cord as far back as the division of the penile crura. Unless all constricting bands are removed, the operation is incomplete. In properly carrying out this procedure the urethral meatus is generally moved backward converting a mid-penile hypospadias, for example, to penoscrotal or anterior scrotal. The longitudinal incision of the dorsum of the penis with transverse suture (H, I) to counteract downward penile bowing is seldom necessary.

properly, no restricting bands will be palpable along the ventral surface of the penis when it is put on stretch.

Excision of the constricting bands which cause the chordee should be carried out by the time the child is twelve months old to permit the penis to grow as straight as possible and to maximal size. When the child is four, five or six years old and there is no chordee, plastic construction of the urethral canal proper is undertaken. We are aware that some advocate delaying all operative treatment until puberty or even later. Yet unless the penis is freed early of adhesions, its growth is hampered and the longer it remains incurvated the more does this form tend to be permanent.

Employment of the Denis Browne technic (Figs. 9 and 10) achieves thoroughly satisfactory results at the earlier age. This is a formation and to his detriment. Although we advise early operation for anatomic and physiologic rather than psychologic reasons, it is undeniable that the boy successfully operated upon at five or six years and who can urinate normally standing up is happier than he who must sit down to void and feels constantly in need of hiding his malformation.

More than two score of technics have been advocated for the construction of a new urethral canal but at present we use only the Denis Browne procedure. (Figs. 9 and 10.) The latter is warmly recommended; in the several boys in whom I have used it, the results have far exceeded those obtained by any other method. Initial preoperative perineal urethrostomy drainage is established and is maintained for about two weeks after completion of the urethroplasty proper. Priapism

and the resulting tearing out of suture lines can largely be prevented by the administration of estrogenic hormones, notably stilbesterol or alpha estradiol, for one day preoperatively and for five days postoperatively. As shown in Figures 9 and 10, two longitudinal incisions are made on the ventral penile surface including and encircling the hypospadiac meatus. The width of this strip is the desired diameter of the new canal. The lateral margins of the incised skin are undermined for 1 cm. or more and are then brought together (" . . . loosely, so they rattle." (Browne)), sutured over and thus bury the undisturbed epithelial strip. Epithelial growth extends from the buried skin strip; in three weeks a new urethral canal of remarkably satisfactory caliber and later lined with epithelium is achieved.

Subsequent to operation periodic dilation of the canal should be carried out but in our experience scarring has been minimal and without subsequent postoperative chordee.

SUMMARY

Comparatively early operation is advised both in cryptorchism and in hypospadias. In cryptorchism the reasons for early correction of the malformation are largely physiologic and are related to the promotion of normal testicular growth and spermatic maturation. Accompanying congenital hernia is common and should be simultaneously repaired. The presence of congenital hernia calls for surgical treatment without hormone therapy. When there is no hernia, use A.P.L. hormone up to a total of 2,500 rat units and if this fails to cause the testicle to descend, operate.

In hypospadias satisfactory correction of the congenital chordee can and should be accomplished by the end of the first year. By urethroplasty and particularly by the Browne technic, a urethral canal discharging at the tip of the glans can be made when the boy is five years of age, at which time intimate association with his friends and schoolmates begins.

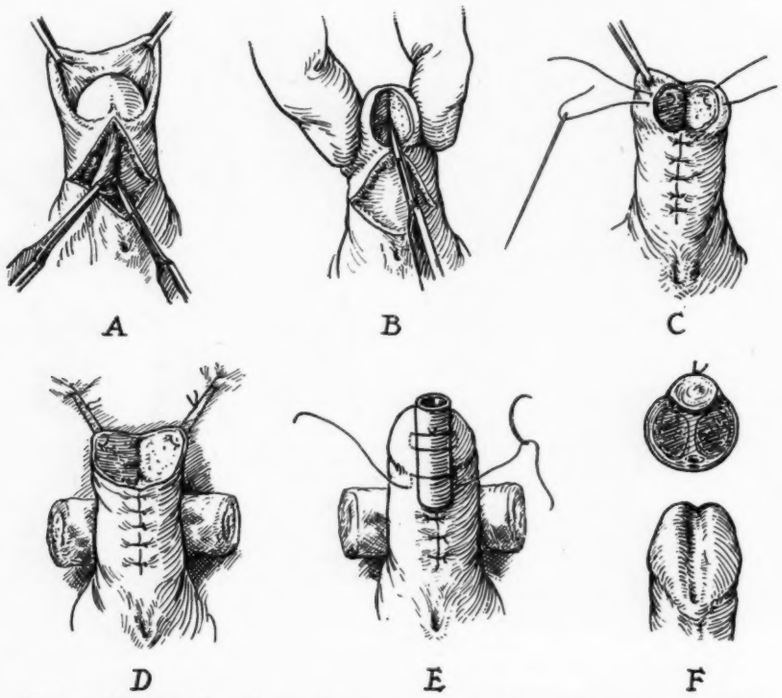

FIG. 8. Hypospadias. Surgical treatment. Initial operation for correction of congenital chordee when the Browne procedure (Figs. 9 and 10) is to be employed. The ventral restraining bands are excised and the ventral glans penis is incised and permitted to heal as a wide deep groove as suggested to the writer by Didusch. The wound margins of the glans are kept separated during healing by a small rubber tube (E) or a small petrolatum gauze roll held in place by two sutures. (From Campbell, M. Clinical Pediatric Urology. Philadelphia, 1951. W. B. Saunders Co.)

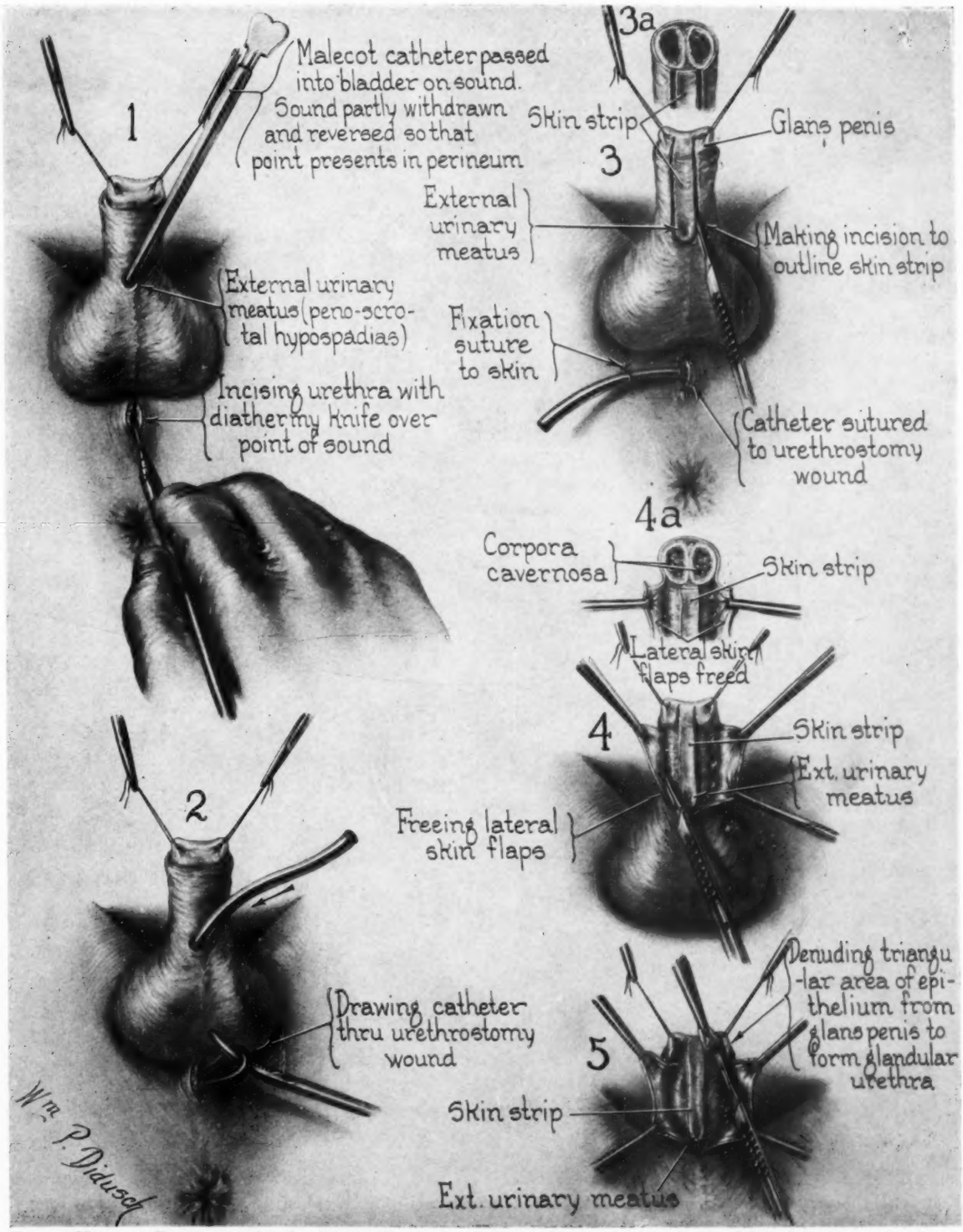

FIG. 9. Hypospadias; correction by Denis Browne procedure. (From Campbell, M. Clinical Pediatric Urology. Philadelphia, 1951. W. B. Saunders Co.)

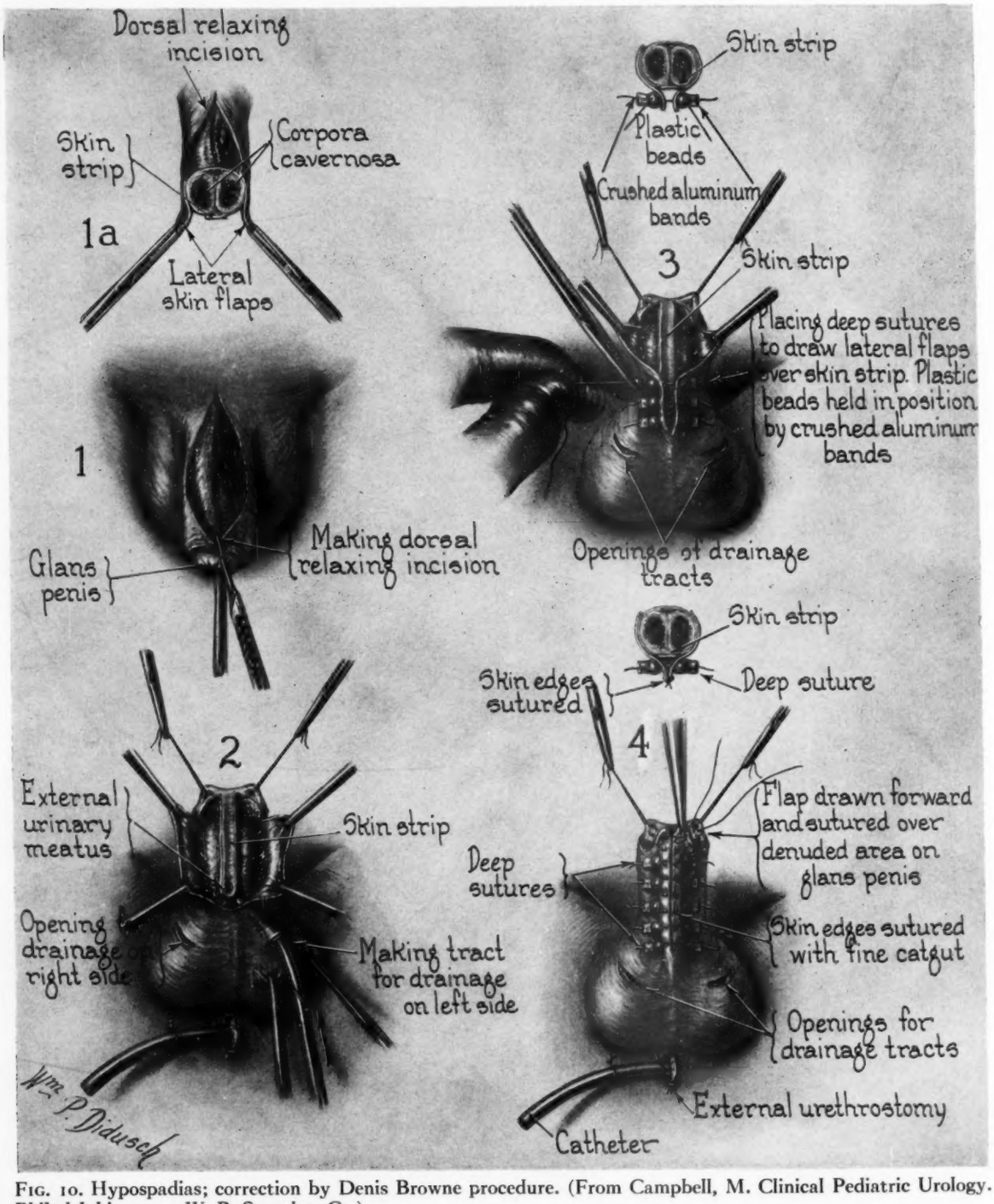

FIG. 10. Hypospadias; correction by Denis Browne procedure. (From Campbell, M. Clinical Pediatric Urology. Philadelphia, 1951. W. B Saunders Co.)

Operation is advised for anatomic and physiologic reasons rather than for psychologic considerations; the last merits scant concern in organizing the surgical program. Psychologically, the parents usually suffer infinitely more than does the boy and are commonly the greater management problem.

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THE ROMANCE OF TRAUMA

THE DEVELOPMENT OF THE SURGERY OF TRAUMA

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THE need for surgery following trauma is felt among the mighty and the lowly. In the history of our country three Presidents have died of assassins' bullets and one recovered from a would-be assassin's attack. Abraham Lincoln died within twenty-four hours. President Garfield died after a lingering illness following a gunshot wound on July 2, 1881, and William McKinley died in Buffalo in 1901. Theodore Roosevelt was shot in the city of Milwaukee and recovered. These tragedies have been recorded in detail and should be read by all who are interested in the surgery of trauma.

Contrast if you please the happenings in 1865 and 1881 with what would have taken place in 1948 or 1949. President Lincoln was shot in Ford's Theater. He was removed to a residence across the street from the theater where in the early morning hours he passed away.

James A. Garfield was shot in the railroad station of the Baltimore and Potomac Railroad in Washington, D. C. According to J. Howe Adams[1] the President was " . . . carried at once to the second story of the station building and placed upon a mattress, sedatives were administered and the wound of entrance was probed by the passage of a Nelaton probe, which was followed by the introduction of the finger of the examining physician. There was absolutely no data to show the course of the bullet or its location, to these men whose trained minds would have detected the slightest indications, had they existed. Owing to the nausea, vomiting, and general prostration which appeared it was found necessary to resort to feeding by the bowel."

After a lingering illness President Garfield died on September 19, 1881. Autopsy revealed that the bullet had passed through the body of the first lumbar vertebra and had become encysted below the border of the pancreas. Hemorrhage from an old injury of the splenic artery was the cause of the final outcome of the case.

Visualize for a moment an American citizen shot down as the President was. What would happen today? An ambulance would be immediately summoned and within a few minutes would transport the patient to a hospital where transfusions and x-ray pictures for localization would probably be made soon after admission. Certainly there would be no probing but deliberate operative procedure would be resorted to, antibiotics would be administered and careful nursing would enhance the chances of recovery of the wounded man.

What can be more romantic than the dramatic developments which have made it possible, for man's humanity to man, to have made such strides in such a short period of time? Romance is defined as a tale of adventure of some hero or a fictitious narrative. The romance which we wish to discuss deals with the great adventure of those men in the past who for the love of their fellows sought to unravel the mysteries surrounding man; they sought to draw the veil which hid the secrets of the universe. The long line of heroes have, each in his turn, added light so that the taper of old might become the glow of the present and, by the gradual unfolding for future time of knowledge, might be like the radiance of the sun.

The heroes of medicine have been and will continue to be consecrated devotees of Abou Ben Adhem's dream:

> "I pray Thee, then
> Write me as one
> Who loves his fellowmen."

As we look over the history of the development of this romance, we see evidence of change from the darkness of despair to dawns of new horizons; we see a change from a sense of finality in the days of the dogmatism of Galen until the Renaissance brought a hopeful outlook on the mysteries yet to be unfolded for the better care of the injured. In preparation for this adventure I have spent time with

Ambrose Pare, John Hunter, Percival Pott, Astley Cooper, Robert Knox, Lister and many others in the passing parade of immortals, trying to gain inspiration from their accomplishments in the hope that others might enjoy the romance with me.

Those things which are taken for granted today, actually prerequisites for the practice of surgery, were either not known or an opportunity to gain knowledge of the basic factor, anatomy, was banned by legal and religious restrictions.

From Galen's time in the second century (A.D.) until the early part of the sixteenth century when Andreas Vesalius and Leonardo da Vinci appeared on the scene the curtain of darkness prevailed.

Fielding Garrison in speaking of Vesalius said, "His mind was too active, his spirit too keen and independent to feed long on the dust of the ages. . . . Vesalius was the 'Faust' who was to release the subject (Anatomy) and make it what it is today, a living working science."

McMurrish in his illuminating volume, "Leonardo da Vinci—The Anatomist,"[2] asked the question: "Why was it that the Anatomist of the Fourteenth and Fifteen Centuries added little or nothing to the scanty and superficial description of the human body contained in the Canon of Avicenna?" He attempted to answer this: "Because in the first place Avicenna was epitomizing the 'Anatomy of Galen' while the more modern writers were epitomizing 'Avicenna's Epitome.'"

The thinking of the period in which da Vinci lived is well epitomized by McMurrish: "Conventionalism is dogmatism crystallized, and dogmatism means finality." Galenic traditions had been preserved through the dark ages by translations of the Arabic School. Da Vinci's inquisitive mind could not be satisfied by reading translations; he was interested in observations. According to McMurrish he found: " . . . much worthy of imitation in the works of antiquity, but, never-the-less, had nothing but condemnation for those who followed them servilely, when the grandest of all books, I mean the Universe, stands open before our eyes. Those who study only the ancients and not the works of Nature are step-sons and not sons of Nature, the mother of all good authors.[2]

Da Vinci's contempt for traditional word description as opposed to graphic illustration based on observation can be found in the following quotation: "Oh Writer, with what words will you describe the entire configuration with the perfection that the illustration here gives? This, not having knowledge, you describe confusedly and allow little information of the true form of things, deceiving yourself in believing that you can satisfy the auditor in speaking of the configuration of any corporeal object bounded by surfaces. But I remind you not to involve yourself in words, unless you are speaking to the blind, or if, however, you wish to demonstrate by words to the ears and not to the eyes of men, speak of substantial or natural things and do not meddle with things pertaining to the eyes, by making them enter by the ears, for you will be very far surpassed by the work of the painter."[3]

In order to accomplish what da Vinci did it was necessary for him to do many "Anatomies" (dissections). It has been said that up to that time he had dissected more than anyone else. It must be realized that the only bodies which could be dissected were those of individuals who had been hanged.

Restrictions on obtaining anatomic knowledge did not disappear until the first third of the nineteenth century, especially in 1832 when the Warburton Act in England legalized the study of anatomy. It is not to be understood that in the period between da Vinci's time and 1832 those who sought to learn anatomy had an easy time. All sorts of devices were resorted to in order to obtain material for anatomic studies. Necessity brought into close contact men of the highest standing and of the lowest types. Great surgeons and great anatomists linked themselves with "grave snatchers" or "resurrectionists" in order to accomplish their ends. The lives of many men were embittered or even destroyed because of the hue and cry against those who attempted to advance the knowledge of anatomy.

The story of Robert Knox of Edinburgh is a particular case in point. The Robert Knox we are discussing although a Scotsman must not be confused with John Knox the Reformer. Robert Knox was born September 4, 1791. In 1810 he began his study of medicine at Edinburgh. In 1823 he became a Fellow of the Royal Society of Edinburgh. At that time the museum of the Royal College of Surgeons was "a very poor affair" (Londsdale).

In 1824 Dr. Robert Knox submitted a plan for the formation of a museum of comparative

anatomy. In a letter submitted to the College of Surgeons he stated: "I am willing to bestow my whole labor and time. I am moreover, willing that the Museum so erected be considered as the property of the College."

In 1825 he became a partner with Dr. John Barclay who had been teaching anatomy for many years. The following year Barclay died but he had stipulated in his will that " . . . this Museum wherever deposited should be available for Knox's use in lecturing."

Londsdale said, "Knox was more than a successor to his distinguished master; he was himself, and soon came to be designated by his class as 'Knox Primus et incomparabilis.'"

With increasing fame as a lecturer there was greater need for anatomic material. Knox like Sir Charles Bell, Astley Cooper, Liston and many other great names in the history of surgery had to deal with resurrectionists. A visit to Gray Frior's Cemetery in Edinburgh will satisfy the most incredulous among us. The Mort-Safes which were built over graves give one the impression the he is looking at cages in a zoologic garden. Even these Mort-Safes and watchers did not prevent the expert resurrectionists from removing the remains of those who had been interred. The resurrectionists were not satisfied with desecrating graves, but the celebrated Burke and Hare would lure people to their den where after plying them with liquor they would asphyxiate the victims and sell the bodies to the anatomists. The vileness of these crimes aroused public sentiment and put an end to the so-called Burking; however, at the same time the life of Robert Knox was ruined in Scotland. The body of one such murdered woman was found in the rooms of Dr. Knox. Knox was condemned by the rabble, by the press, by his rivals in the profession and in rhyme:

> "Burke's the butcher, Hare's the thief,
> Knox the man that buys the beef."

In the beginning Knox remained silent but he was finally forced to express himself publicly after a committee had been formed to investigate the entire affair. This committee found only one cause of censure for Knox; he did not make particular inquiry of the persons bringing the bodies as to the place and mode of obtaining them.

Dr. Knox's statement contains a most interesting thought: "Candid men will judge of me according to the situation in which I was placed at the time, and not according to the wisdom which has unexpectedly been acquired since."

Professorial honors and titles which his ambition sought and his worth merited were denied him by contemporaries who were jealous of the real stature of the man. Like Moses from the Mountain he saw the promised land. During life he was denied. He did, however, live to see the unfortunate episode which interfered with his own happiness and success result in the liberation of anatomic teaching from the hands of resurrectionists.

In 1832 the Warburton Act legalized anatomic dissection in England and made the work of the Professor of Anatomy a respectable and legal profession.

There are few scenes in the romantic drama of the surgery of trauma more fascinating than those which have to do with the development of anatomic knowledge, the basis on which surgery is founded.

Sir Astley Cooper, the son of a clergyman and one of John Hunter's pupils, whose name is immortalized in anatomy and in the progress of surgery was constantly in contact with resurrectionists. In reporting to the House of Commons in London in 1828 he is quoted as having said, "There is no person, let his situation in life be what it may, whom, if I were disposed to dissect, I could not obtain. The law only enhances the price, and does not prevent exhumation."

J. Moores Ball said,[4] "Cooper could obtain a body, cost what it may. It is no wonder then, that of Sir Astley it might be said that no man knew more of the habits, the crimes, and the few good qualities of the Resurrectionists."

John Hunter, Robert Liston, Sir Charles Bell and many other illustrious names in our history had to resort to the role of resurrectionists themselves or to deal with these grave snatchers in order to leave the immortal imprints of their lives.

In the unfolding of the romance of the surgery of trauma it was not sufficient for our ancestors to become anatomists in order to enter the sacred precincts of the human body with safety. Those who have not taken the time to study the history of medicine take everything for granted. Not enough curiosity is manifested to find out what steps led up to the present period in surgery when one can look forward to the fulfillment of the prophecy of

the late John M. T. Finney who expressed the hope that efforts should be made "to save the hundredth man."

In casting a backward glance we can see the tortured souls on the battlefield at the time of Ambrose Pare. Boiling oil and the hot iron were the means utilized in the treatment of wounds and for the control of hemorrhage. Pare began to use a ligature and thus a new era in surgery was born.

That was not enough; we find vivid pictures of the hospitals at Scutari during the Crimean War just a little less than a hundred years ago. The story of the stench of those wards should be known to all not only because of the great amount of gangrene found in the wards but also because at that time Florence Nightingale appeared on the scene to add another chapter in the romance of surgery—the nursing profession. Only a few years later during our own Civil War the terrible story was written of deaths from hemorrhage, gangrene and the great number of amputations which had to be performed.

Compare those with the experience in the recent war and you will certainly find cause for gratitude that pioneers like Lister appeared upon the scene. Operations prior to the time of Lister were operations of necessity and not operations of election. Watson Cheyne in the first Lister Memorial Prize Medal Address stated: "The story that I have to tell today is one of the most fascinating tales that I know and far exceeds in interest the most exciting detective story ever written, and its influence on the life and health and usefulness of mankind surpasses all imagination; and it is a true story." No one can deny the truth of that statement.

According to Watson Cheyne, Lister was not aware of Pasteur's work in 1864. In conversation Professor Thomas Anderson (Professor of Chemistry in Glasgow) suggested to Lister that it might be worth while to read papers on fermentation and spontaneous generation which had recently been published by a French chemist named Louis Pasteur. Lister's imagination was fired by this suggestion. He immediately sought the information contained in Pasteur's work and waited for an opportunity to apply the revolutionary principles suggested by Pasteur's discoveries. The compound fracture seemed to Lister to offer the best type of case to utilize for his observations. Lister realized that he could not use laboratory methods to kill germs which had invaded or which would invade tissue.

We sometimes marvel at the circumstances which affect the course of human events. In the instance of Lister's utilization of carbolic acid as the antiseptic agent we have one of those curious coincidental circumstances. According to Watson Cheyne, Lister had been attracted by a notice in the newspapers "about the remarkable *results on the sewage of the* town of Carlisle, by the use of Carbolic Acid—a small quantity prevented not only the smell, but also apparently destroying the entozoa which usually infected cattle fed on the pastures on which the sewage was placed."

Professor Anderson obtained for Lister a supply of this acid which was sold under the name of German creosote. From this crude beginning of local antiseptic chemotherapy has evolved our present surgical stature. We must not lose sight of the fact that many otherwise great men were Pigmies attacking the Amazon of the evolutionary as well as revolutionary idea and principle which has benefited mankind in a measure beyond all ability to calculate.

In all human history there appears on the stage at the proper time some individual who by thought and observation as well as by experiment is able to bring to light one of the mysteries of the world in which we live. In his own country Lister was not hailed; he was rather assailed. In our country in the late eighty's there were still surgeons who prided themselves that they had not adopted the Listerian principle. Time marches on and I am sure that the marshal of the armies of progress, Lister, must review with satisfaction the long line of heroes who, following his precepts, have advanced surgery by utilizing the principle enunciated by him.

* * * *

War is tragic no matter how we look at it. If we think in terms of romance as a tale of high adventure, we can see and read into the lessons of war surgery a great romance so far as the chance of survival of the wounded soldier is concerned. If we compare the survival rate, the methods of transportation, the utilization of the fundamental principles enunciated by Pasteur and Lister and the preparation of the wounded for surgical intervention in the Crimean War, our own Civil War and World

War II, we cannot but marvel at the effects produced by the change of scenes in this drama of real life.

As we look back on the experiences of the Crimean war and our Civil War in this consideration of the romantic drama, we cannot fail to be reminded that in the early days of the stage, in Shakespeare's time, the old Globe Theater was devoid of scenery and the props which we consider so essential today. In our drama of real life we find that the surgeons of the middle of the nineteenth century were not provided with Lister's and Pasteur's work, methods of transportation of the injured were primitive, methods of resuscitation were scarcely known, the x-ray had not yet been dreamed of, nursing care was primitive, anesthesia was in the stage of infancy and the necessary personnel for the handling of the wounded was not available.

When the subject of the Crimean War is mentioned, many think of Tennyson's "Charge of the Light Brigade" and Longfellow's "The Lady with the Lamp," and the triumph of Florence Nightingale at Scutari which resulted in the development of nursing education. Few give scant attention or even know the part which the press played in the developments which aroused the indignation of the British public and resulted in better organization and care of the unfortunately wounded soldier.

It is said that the Crimean War was the first in which the special correspondent played a conspicuous part. The dispatches sent to the *London Times* by Mr. William Howard Russell, October 9, 1854, were the torch which lit the way. "Not only are the men kept, in some cases for a week without the hand of a medical man coming near their wounds; not only are they left to expire in agony, unheeded and shaken off, though clutching desperately at the Surgeon, whenever he makes his rounds through the fetid ship; it is found that the commonest appliances of a work house sick ward are wanting, and that the men must die through the Medical Staff of the British Army having forgotten that old rags are necessary for the dressings of wounds."

In another dispatch the same correspondent said: "The manner in which the sick and wounded are treated is *worthy only* of the savages of Dahomey."

The following is an abstract from a letter of Florence Nightingale dated November 14, 1854:[5] "The wounded are now lying up to our very door. . . . Operations are performed in the wards—no time to move them; one poor fellow *exhausted with hemorrhage*, has his leg amputated as a last hope, and dies ten minutes after the Surgeon has left him. Almost before the breath left his body it is sewn up in his blanket and carried away and buried the same day. The surgeons pass on to the next . . . . I am getting a screen now for amputations, for when one poor fellow, who is to be amputated tomorrow sees his comrade today die under the knife, it makes an impression and diminishes his chance; but, any way among these exhausted frames the mortality of the operations is frightful. We have erysipelas, fever, and gangrene."

It is but a short step to the story of the Civil War from 1861 to 1865. "In the great series of 58,702 shot flesh wounds of the lower limbs, besides the groups characterized by lesions to the principal blood vessels and nerves, but extensive lacerations, by lodgments of foreign bodies or extension of inflammation to the joints, there were many examples of complications of pyaemia, gangrene, tetanus, erysipelas, and hemorrhage. Pyaemia—Three hundred and twenty-eight cases of which three hundred and twenty or 97.5% resulted fatally. Hospital Gangrene—The shot flesh wounds of the lower extremity that were distinguished by the supervention of hospital gangrene, numbered 283 with 158 deaths or 55.8%. Tetanus—There were 117 cases of tetanus noticed, with 106 deaths or 90.5%. The mortality following amputations of the thigh was 71.7%. In a group of 386 shot fractures of the hip joint, of 304 which were treated conservatively 249 died. Of fifty-five in which there was an excision at the hip joint 53 died. Following an amputation at the hip joint in 27 cases, 25 died. Of 66 excisions of the hip joint 60 died or 90.9%. Of nine instances of secondary amputations at the hip joint 2 recovered and 7 died, a mortality of 77.7%."

To complete the melancholy picture we find: "Intermediary amputations in the middle third of the leg were performed on 109 patients. Death is ascribed to pyemia in 34, exhaustion in 18, to gangrene in 5, and tetanus in four instances. *There was a total of 2,642 cases of gangrene observed.* Of these 2,366 followed wounds of the extremities."[6] The large majority of cases were instances of hospital gangrene

caused by the crowded condition of the hospitals and the bringing together of many cases of extensive fractures and large operation wounds.

In a report with reference to hospital gangrene Assistant Surgeon J. J. Woodward, United States Army, stated: "In conclusion an allusion may be made to the idea that the peculiar characteristics of this disease are due to the local presence of microscopical fungi. This idea is not borne out by facts. Accurate examination with high magnifying power glass-cases in every stage both where nothing but an ordinary water dressing, as well as in cases in which various forms of antiseptics and caustic washes had been employed, *utterly failed to demonstrate any cryptogamic organisms except the ordinary bacteria which are to be observed in every decomposing animal substance.*" How times change.

One is struck by the variety of agents which were used in the attempts to control the peculiar fetor of gangrene. For fumigation and topical applications solutions of bromide of potassium, 160 gr., bromine, 1 ounce, and distilled water to make four fluid ounces were used.[6]

Labarrague's chlorinated soda solution was used and success reported following its use. "Preparation of Wounds—I am convinced that many surgeons have failed in the treatment of hospital gangrene, because *they have not fully perceived the necessity of thoroughly cleansing the wound of all dead and diseased matter previous to the use of any local application.* Labarrague's Chlorinated Solution has proved quite efficient applied in its full strength, as an arrester of gangrene. A diluted solution of Labarrague's Chlorinated Soda, has been found to answer admirably in these cases, *for when applied in a gentle stream from a syringe it can be made to penetrate into all of the recesses of the disease, destroying all odor and dissolving and removing some of the dead matter attached to the surface of the ulcer.* At about the strength of sea water it seems to properly stimulate the structures, as well as cleanse them. In all cases of ulceration, where no gangrene remains we wash the surface once or twice a day with this solution, dilute it, and saturate the dressings with it as often as they get dry, or once in two hours, and are well pleased with the result."

To those who have been deluded by thinking that the idea of using chlorinated soda was an invention of Dakin or Carrel this should be a sharp reminder.

Under the heading of Pyaemia[6] we find: "The terms septaemia, septicamia, pyaemia, etc., found on the surgical reports of the war, were probably used by the surgeons as expressing in their opinion, certain degrees or phases of blood poisoning, intelligible to themselves, but which the description of cases failed to reveal and which therefore, have not been adhered to here. The total number of cases of pyaemia after shot wounds was 2,818 of which 71 recovered, and 2,747 terminated in death—a mortality of 97.4%." It is safe to say that in many, perhaps in the large majority of these cases, the pyaemic infection was induced or influenced by the operative interference.

The experience of the army surgeons at that time did not bear out later claims for maggots. "The presence of maggots in wounds, in the field and camp hospitals was frequently an annoying complication. . . . Nothing but frequent dressings will keep them from developing in the wounds. Oil of turpentine and infusions of tobacco were used to kill these pests." This quotation is introduced for the purpose of bringing to mind that during the last twenty years the subject of the usefulness of maggots in the handling of infections occupied the time of the profession and space in medical journals. The wave of enthusiasm has fortunately died down.

By contrast with the great number of patients who died in hospitals during the Civil War the experiences of World Wars I and II should suffice to indicate the great advances which have been made in the handling of the wounded.

"In World War I there were 153,537 battle casualties admitted to hospitals. The deaths from battle injuries in the same period amounted to 12,470 or approximately 12 per cent. There were 25,272 fractures and 2,751 deaths from fractures, or a little more than one in ten died following injuries involving the skeletal system."[7]

Howard Snyder and James W. Culbertson analyzed the total of 91,631 casualties in the Fifth Army from January 1, 1944, to May 2, 1945:[8] "Killed in action or died before reaching the hospital 16,648 or 18.17%. Wounded or injured in action, admitted to the hospital and lived 61,393 or 67%. Wounded and injured in action, admitted to a hospital and died 1. 7/8%.

Immediate cause of death in 1,450 battle casualty deaths reported in the Fifth Army Hospitals: 36.1% died of shock and 3.5% died of clostridial myosites."

Let us inquire into the reasons why so many lives were saved and eventually so many men were rehabilitated when we compare the experiences of the Civil War and World Wars I and II.

A factor of tremendous importance is the *transportation of the wounded man.* The proper organization of personnel for this important phase of the care of the injured in our Army is an extremely interesting chapter. In the medical history of the Civil War we find in a report of the Surgeon General of the United States Army the following statement:[9] "No organized ambulance corp existed in the army at the beginning of the War. In April 1862, Medical Director Tripler, of the Army of the Potomac, called attention to the absolute necessity of having an experienced Quartermaster and an Assistant Commissary of Subsistence attached to the command of the Chief Medical Officers of an Army in the field. The General-in-Chief of the Armies, H. W. Halleck, objected to such an organization."[9]

Fortunately the Commanding Officer of the Army of the Potomac, Major General McClellan on August 2, 1862, signed General Order Number 147 authorizing: "The organization of the Ambulance Corp and the management of ambulance trains." This Order according to the Surgeon General's Report was issued at the insistence of Surgeon Johnathan Letterman, Medical Director of the Army of the Potomac.

In 1863 again at the insistence of Surgeon Letterman General Grant issued General Order No. 22 from his Headquarters at Youngs Point, Louisiana, authorizing and regulating the Ambulance Corps.[9]

"The establishment of a uniform system of ambulance corps in the Armies of the United States was not accomplished until the spring of 1864, when Congress passed an Act which was approved by the President March 11, 1864."

The transition from the primitive organization of 1864 to the well organized provisions for transportation culminating in the use of air transport under the direction of Surgeon General Normal T. Kirk in World War II has saved an incalculable number of lives and limbs. By the way of digression it might be noted that General Kirk at one time served in the Letterman Hospital, San Francisco, as the Director of the Surgical Division.

We might well be proud of the fact that Norman T. Kirk, under whose direction so much was accomplished and who must have been inspired by association with the name of the man who was responsible for the organization of methods of transportation and the ambulance corps, is a member of the Committee of Trauma of the American College of Surgeons.

X-RAY

In considering the romance of the surgery of trauma we must of necessity pay tribute to those pioneers like Percival Pott, Astley Cooper, Velpeau, Colles, Desault, Bigelow, Liston, Hamilton, Gibney and a host of others who in the days before x-ray did so much for the individual who had suffered a fracture or dislocation. We marvel at their ingenuity and the knowledge of anatomy which they possessed and which they utilized for diagnostic purposes as well as for the management of fractures which came under their observation. It is a great pity that many men today instead of using their power of observation and knowledge of anatomy avail themselves only of a rapid method of making a diagnosis—the x-ray.

Times have changed but people remain the same. A curious circumstance found today is a keen reminder of a statement made by Percival Pott, in 1775: "No part of surgery is thought to be so easy to understand as that which relates to fractures and dislocations. Every, the most inexpert, and least instructed practitioner, deems himself perfectly qualified to fulfill this part of the Chirurgic art; and the majority, even of these, are affronted by an offer of instruction, on a subject with which they think themselves already so well acquainted."

How often have we seen this same thing in our own experience. For some strange reason the intern on his first service is often placed on emergency duty and he feels affronted if he is not allowed to handle unassisted *so simple* a case as a fracture about the wrist. It has always seemed curious that such cases are left in the hands of the most inexperienced at a time when the utilization of some knowledge and experience might avoid unhappy conditions which result in disability for the patient. After the disability arises on some hospital services it becomes an administrative problem to decide

Scene in the operating amphitheater of Massachusetts General Hospital, 1888. Ether is being administered to the patient by placing a sponge soaked with the drug over the nostrils. All of the operating room personnel had either beards or mustachios, but masks, caps or gloves were unknown.

Bettmann Archives

which one of the specialty groups is to handle the patient.

Here again we might profitably be reminded of an axiom so well stated by Percival Pott: "It is demonstratably true that a broken bone cannot too soon be put to rights."

The importance of a knowledge of anatomy, particularly the origin, insertion, and action of muscles, was emphasized by Pott: "Neither extension, nor counter-extension, can ever be necessary on account of the mere fracture, considered abstracted. The broken ends of the bones are of themselves inactive; and if not acted upon by other parts, they would always remain motionless. What then is the reason why fractured bones always suffer a greater or less degree of displacement? What are the parts or powers which act on the bones, and which, by so acting on them produce all these consequences? These parts are the muscles then, and the only moving powers in an animal body. From the muscles then and from them only proceed all the difficulties which we meet with in making our extension; and by the resistance of these, and of these only, are we prevented from being always able to put the ends of a fractured bone immediately into the most apt contact."[10]

Until the discovery of x-ray in December, 1895, by Wilhelm Conrad Roentgen attempts at reduction of deformity following fractures were undertaken by men who made their diagnosis by and through their knowledge of anatomy. Unfortunately in a few years the purely mechanistic view of broken bones seemed to take hold of the profession. This is best exemplified in the teachings of a great pioneer, Lane. Once a diagnosis of fracture was made with the x-ray the patient was taken to the operating room and a metal plate applied. Reliance was placed on the relative safety gained through aseptic technic and individual skill without due consideration for conservative methods which if properly applied along anatomic lines might have resulted in less morbidity and mortality. With increasing experience and intelligent discrimination the rule of thumb is no longer applied and increasingly we find individuals who by training and interest are giving intelligent care to this field of trauma.

The x-ray has not only revolutionized the management of skeletal injuries but also has been an agent which has been helpful in revolutionizing the surgery of trauma in every field to say nothing of the beneficent effect in the development of the frontiers of surgery.

Probably the first war in which the x-ray was used was the Spanish-American War in 1898. Soon after the discovery by Professor Roentgen of the new form of irradiation and the placing on the market of an apparatus for its production the Surgeon General of the Army supplied Roentgen Ray apparatus to several of the larger post hospitals.

Borden[11] states: "In all seventeen apparatus available during the war, the use of Roentgen ray has marked a distinct advance in military surgery. In the Spanish American War, apparatus was supplied to General Hospitals and Hospital Ships only. None were used in movable hospitals or in the fields. Experience with its use in the late war and the conditions of military surgery lead to the conclusion, that the use of the apparatus in movable hospitals is not advisable and that its use should be restricted to permanent base and general hospital ships."

Abbott reporting on experiences in the Graeco-Turkish War stated: "The use of the Roentgen Ray becomes an impossibility at the actual front; fortunately it is not necessary there, *and could very possibly, do harm by stimulating the young surgeon to premature operations under bad circumstances.*"

The present x-ray is a far cry from the old coil and battery type apparatus and static machine, from the glass plate and the inflammable film, and from the type of x-ray tube which required an exposure of from one to twenty minutes. The tragedy of long exposures which the pioneers in x-ray therapy were subjected to contains a list of the names of many of the pioneers in the development of roentgenology. The records of the loss of life and limb of these pioneers represent the sacrifice by these men that others might live and work with greater safety.

ANESTHESIA

Surgery as we know it today could not have extended its fields of usefulness without the variety of comparatively safe anesthetic agents now in use. (Even though ether was first used in 1842 by Crawford W. Long and four years later the surgical world was given a demonstration in a surgical amphitheater by Morton on a patient operated upon by Dr. Warren at the Massachusetts Hospital, its Universal appli-

cability was not appreciated as late as the time of our own Civil War.[12] "The inestimable value of the use of anesthetics in military surgery will hardly be denied at this date, although it has been claimed that the effects of anesthetics in the treatment of shot injuries are deleterious, in as much as they add to the depression caused by the shock, and retard union by first intention, and predispose to hemorrhage and pyaemia. It is possible that in two hundred and fifty-four cases in which it was asserted that no anesthetic was given, the surgeons were actuated by such objections, as no reasons have been assigned why anesthetics were not administered."

Soon after the turn of the century spinal, local, intravenous and intratracheal anesthesia were utilized. With the passing of time newer and less toxic agents have been utilized and the dangers of surgical procedures have been greatly reduced.

Even though aseptic technic had been developed and we had the trained nurse and a long array of comparatively safe anesthetic agents, one important factor still remained which had to be developed to increase the safety of surgery in trauma. That important factor, preparation of the patient to make him safe for surgery as well as the surgery safe for him, has been dealt with in a spectacular manner in the last few years and now the importance of maintaining proper fluid balance and replacing blood loss is generally appreciated.

Only those who have lived through the period of this development can really evaluate the change.

Not too many years ago when a patient approached the shock stage, an infusion of saline and glucose and various hypodermics, thought to be stimulants, represented almost the entire resources of the surgeon. An occasional blood transfusion was given. This was a major procedure. Various substitutions for blood were used and not too long ago plasma was thought to be an adequate replacement. With the development of our blood banks the giving of 2,000 to 3,000 cc. of blood is not an uncommon experience.

Transfusion, once a formidable procedure, has become so easy and so much of a routine that the younger men scarcely worry about the difficulties which beset the path of those who have brought our knowledge to its present high plane.

The trails blazed by pathfinders should be a stimulus for the ambitious within the profession to carry on the high adventure.

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HEMIPELVECTOMY FOR TUMORS OF BONE*

REPORT OF FOURTEEN CASES

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A HEMIPELVECTOMY may be defined as an operation which removes *en masse* an entire lower extremity together with the corresponding innominate bone and contiguous muscles. Strictly speaking, procedures which fail to divide the sacroiliac joint and symphysis pubis (Fig. 4E) should not be termed *hemipelvectomy*. Among the many different names which have been given this operation by surgeons who have described it in connection with reports of cases in which it has been carried out are the following: interilio-abdominal disarticulation,[1] interilio-abdominal amputation,[2] interpelvi-abdominal amputation,[3] ilioabdominal amputation,[4] hemipelvectomy[5] and hindquarter amputation.[6]

This major procedure was employed more than fifty years ago, and one must feel a sense of great admiration for the courage of those bold and intrepid surgeons who were pioneers. Despite early failures and a prohibitive mortality the procedure was not forgotten and in recent years, with vastly improved mortality rates, it is gaining recognition both here and abroad.

While Billroth[2] (1891) is credited with being the first to perform hemipelvectomy, Girard[1] had the first surgical success. Hogarth Pringle[3] and Gordon-Taylor[6] made distinct contributions; the latter seems to have stimulated a revival of interest in the operation when in 1935 and again in 1940 he reported impressive results in patients he had operated upon; in fact, by 1946 his own series had reached a total of twenty-one cases.

Saint,[7] in a recent paper, emphasizes the striking reduction in operative mortality. While in the early years this was about 70 per cent, ten years later it had been cut in half; at present it is estimated at approximately 15 per cent—although this figure can unquestionably be lowered still further. We know of several surgeons who have not had an operative fatality in series ranging from five to more than a dozen cases.

Indications. One of the principal indications for hemipelvectomy is primary bone sarcoma of an innominate bone (Fig. 2A) or of the proximal end of the femur with extension beyond the limits of a hipjoint disarticulation. (Fig. 4C.) In this communication a series of fourteen such consecutive operations is presented from the standpoint of selection of cases, technical considerations of the operation, preoperative and postoperative management and, in particular, the postoperative complications and prognosis.

Of this series of fourteen cases three were osteogenic sarcomas and eleven were chondrosarcomas; the latter were all of the type which we regard as secondary to preexisting chondroma (Fig. 4A) or osteochondroma. In the light of our own experience as well as that of others, we now consider hemipelvectomy to be less justified in osteogenic sarcoma since the end results are poor; and in the future we shall seldom advise it for bone sarcoma unless it is of the low-grade chondrosarcoma variety.

Age. The average age of the patients in this series was greater than is found in osteogenic sarcoma or primary chondrosarcoma as a whole; the youngest was twenty-eight and the oldest sixty, the average age being 45.0; nine of the fourteen patients were between forty-two and forty-eight years of age.

Sex. There were twelve males and two females, an even greater preponderance of the male sex than is true for these tumors as a whole.

Site of Tumor. The site of origin was in the proximal femur in three cases, ilium in nine and pubis in two cases. In each instance a preoperative chest film was negative for evidence of pulmonary metastasis.

Treatment Prior to Admission. Prior to admission various procedures, such as biopsy,

* From the Bone Tumor Department, Memorial Hospital, New York, N. Y.

roentgen therapy and incomplete attempts at removal of the tumor had been carried out in eleven of the fourteen cases. Wound infection, soft-part recurrence and alteration in the histologic grade of the tumor made the radical operation more difficult and the complications more frequent, and in some instances may have affected the ultimate outcome adversely. Three patients had been subjected to open biopsy elsewhere approximately one month prior to admission to Memorial Hospital. In one of these, wound infection developed necessitating a three-weeks' delay before hemipelvectomy could be performed and resulting in prolonged convalescence due to delayed healing of the wound which had become mildly infected. Two patients had received rather extensive preoperative roentgen therapy elsewhere. Two patients had been operated upon, one six months prior to admission when a considerable portion of the tumor was removed; this was followed by the appearance of several spherical nodules of tumor in the soft parts of the inguinal region and the lower quadrant of the abdominal wall; and the other, fourteen months prior to admission when local excision was attempted. Of the entire fourteen cases only three had received no treatment prior to coming to our clinic.

Diagnosis. Most of these cases presented the cardinal signs of a malignant tumor, i.e., pain, swelling and disability. There was a marked difference between the osteogenic sarcomas and the chondrosarcomas. The history of the latter was more protracted; the swelling had been of slower development, painless at first but later taking on a more rapid growth and being associated with pronounced pain. This period ranged from two to fifteen years and provided strong corroboration of our theory that most of these chondrosarcomas of the hip and pelvic bone are secondary sarcomatous evolutions of benign chondromas.

The osteogenic sarcomas, in contrast, gave much shorter histories ranging from one month to six months from the first symptom until admission to the hospital.

Pbysical Findings. The considerable investment of soft parts over the pelvic bone and proximal portion of the femur make it possible for bone sarcoma to attain rather large size before swelling is obvious on inspection and even by palpation. Thus the bulky secondary chondrosarcomas may attain a large size. (Fig. 4D.) Atrophy of the muscles of the corresponding extremity is often present and may be determined by mensuration.

Roentgenographic Findings. Much valuable assistance is provided by adequate roentgenograms including stereoscopic views. They suggest with fair accuracy the size and extent of the lesion, the encroachment upon the adjacent sacrum, the extent of involvement beyond the midline, and in many instances they have permitted the roentgenologist to forecast the pathologic type of the tumor. In two of our cases the bone involvement was slight and the tumor resembled a malignant soft-part lesion. Chest films are obviously essential and none of our cases presented evidence of lung metastasis prior to operation.

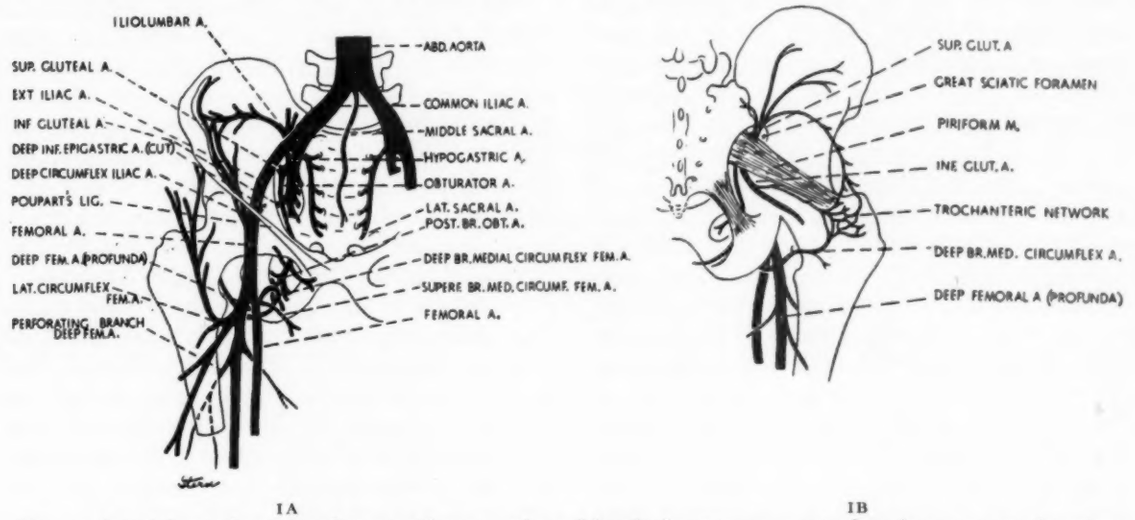
Histologic Diagnosis. In the cases of osteogenic sarcoma the microscopic findings were wholly consistent and reliable; but where the tumor was of cartilage origin, it was evident that one could not rely entirely upon the histologic diagnosis unless it revealed chondrosarcoma. Aspiration biopsy for such lesions may not be reliable. While open biopsy may reveal only chondroma, microscopic study of the whole tumor may prove it to be chondrosarcoma. We have learned that a large cartilage tumor of the proximal femur or pelvic bone (Fig. 2A) which on roentgenograms appears to be malignant should not be considered benign when the biopsy report is "chondroma." Furthermore it should be emphasized that a diagnosis of chondroma on one or more previous operations does not mean that that tumor may not at a later date prove to be chondrosarcoma. We are always suspicious when a patient who has had several operations with tissue reported as chondroma continues to have symptoms, physical findings and roentgenographic features of persistent tumor. (Fig. 4B.) In such a case the chondroma has, in all probability, become a chondrosarcoma.

OPERATIVE TECHNIC

Preoperative Care. It may be assumed that before a patient in whom hemipelvectomy is contemplated is brought to the operating room any defects in blood volume and hemoglobin have been corrected by transfusion of whole blood. Four cases in the present series required preoperative transfusion (500 cc. in two cases, 1,000 cc. and 1,500 cc. in each of the other two).

High protein, high caloric and high vitamin diet was the rule prior to operation.

Skin preparation must be given careful attention; the area should extend from the costal margin to the knees on both sides. The inguinal, pubic and anal regions require special



IA IB

FIG. 1. Arterial supply as it relates to the operation of hemipelvectomy. A, anterior view; B, posterior view.

care. The patient should come to the operating room with sterile towels covering the operative field. To reduce, if possible, the chance of contamination by bowel organisms, we use sulfasuxidine by mouth for three or four days before operation. Penicillin is commenced twenty-four hours prior to operation and aureomycin may be added as soon as it can be tolerated orally. The patient comes to the table with a Foley catheter in place; this is connected to a tidal drainage system after operation.

Technical Procedure. It is not our purpose to describe the operation of hemipelvectomy in detail since it has been more or less standardized by recent writers on this subject, but we wish to emphasize some of the points that are helpful in reducing the three main complications of this procedure which are shock, hemorrhage and late infection of the wound. Some authors have mentioned the necessity for shifting the patient on the operating table as many as three times during the operation. We have adopted a technic which requires only one shifting of the patient, the remainder of the operation being done with him in a supine position. We divide the symphysis pubis with a scalpel and an osteotome, preferring this to the Gigli-saw method. At times the entire division can be done with a scalpel. The problem of hemostasis is most serious and has caused some surgeons to ligate the common iliac artery, or both the external and internal iliac artery below the bifurcation. The internal iliac artery through the gluteal branches supplies nourishment to those tissues which are destined to form the posterior flap and whose blood supply is jeopardized by ligation. (Fig. 1.) We prefer to ligate the external iliac artery and temporarily occlude the hypogastric artery by means of a rubber-covered bulldog clamp (seraphin). This clamp is not released until the limb is removed and the large branches of the gluteal artery clamped. At this time there is good exposure of all the soft parts, and bleeders can be caught readily when the seraphin is released. This markedly reduces blood loss and consequently the quantity of blood that must be administered during the operation need not be more than from 2,000 to 3,000 cc.

Another significant detail is the question of drainage. Since in this operation one closes the fascia, skin and subcutaneous tissues directly over the underlying, unopened peritoneum, there is a potential dead space in which large amounts of blood and serum can accumulate; therefore, drainage is imperative. We place a cigarette drain at either end of the incision and have learned by experience that too early removal of these drains will result in some instances in a collection of serum and blood beneath the skin which can reach considerable size, interfere with wound-healing, require further incision and drainage for its removal and materially prolong the period of hospital-

ization or may even necessitate a later readmission to the hospital.

Postoperative Management. The maintenance of a normal plasma protein level and normal blood volume together with an adequate hematocrit are essential. In our experience all these patients will require blood transfusions postoperatively even though blood has been generously supplied during the actual procedure. During the first week after operation the amount of blood required varies from 500 to 2,000 cc. In one patient the hemoglobin fell to 9 gm. and the hematocrit to below 35 per cent. The early resumption of oral feeding, of course, helps to maintain the normal fluid and electrolyte balance.

The exposure of a large part of the parietal peritoneum and its contents and the unavoidable trauma associated with this major procedure are responsible for varying degrees of abdominal distention and atony of the bladder. The latter is aggravated, no doubt, by homolateral section of the sacral plexus. Consequently, bowel distention is combatted with Wangensteen suction, a rectal tube used at intervals and the use of prostigmine. Oral alimentation is usually withheld for thirty-six to forty-eight hours during which time fluid balance is maintained by infusions of 5 per cent glucose in water or in normal saline.

Atony of the bladder is combatted by tidal drainage which is attached to the Foley catheter after the patient is returned to his room. While this may be required for three or four days in some patients, in others there is practically no bladder dysfunction.

While we are convinced of the desirability of early ambulation and get most of our patients out of bed on the day after operation, this for a hemipelvectomy may be a rather rugged experience; instead we get these patients out of bed on the second, third or fourth day, and within five or six days they are encouraged to walk on crutches which most of them do.

It has seemed desirable to continue the use of antibiotics until one is assured of healing of the wound. This operation entails a long incision whose inferior angle is necessarily rather close to the anus so that exposure to infection is much greater than is the case for most surgical wounds. Experience has taught us that it is desirable to postpone the first dressing as long as possible, sometimes until the seventh day. Our series shows the first dressing to have been postponed longer in the later cases than in the earlier operations. After the first dressing the wound is cleansed and redressed every day. We would again emphasize that this is the one variety of amputation in which too early withdrawal of the drain must be avoided.

Pathologic Findings. We have already mentioned that there are only two histologic types reported in this series of fourteen cases, namely, osteogenic sarcoma (Cases VIII, X and XII) and chondrosarcoma (Cases I to VII and IX, XI, XIII and XIV). As already stated, the three cases of osteogenic sarcoma yielded such unfavorable results following hemipelvectomy that we now doubt the justification for employing the procedure in this type of tumor.

Extension of the tumor to the level of resection and involvement of iliac lymph nodes and vein are factors which have a definite influence on the prognosis. In three cases there was extensive invasion of the iliac nodes and vein involvement; one of these was an osteogenic sarcoma (Case X) and had a short survival period of three months. One was a chondrosarcoma with extensive invasion of the soft parts and a huge tumor 67 cm. in diameter which crossed the midline of the pelvis; this patient survived for twenty-six months (Case III). Another, Case IV, had an extensive tumor that had been diagnosed microscopically as "low-grade chondrosarcoma; tumor present at the line of incision"; this patient is now in his thirty-first postoperative month without evidence of a recurrence of the disease.

Complications. A particularly troublesome problem has been presented by two postoperative complications: necrosis of the posterior flap and persistent drainage from the wound. With these two exceptions, the postoperative course in this series of cases has been comparatively smooth. Hemorrhage *per se* was never observed although a slowly developing hematoma deep in the wound was noted twice (Cases VIII and XIII). Secondary anemia, described by many authors as a troublesome complication, occurred only as an immediate postoperative complication and yielded to blood transfusions without sequelae. Case VIII had a fall of hemoglobin to 7.8 gm. and required 2,000 cc. of blood during the first postoperative week.

We have not been impressed with the prolonged effect on hemopoiesis of the removal of such a large amount of medullary bone. Pul-

monary complications may be fairly frequent in the first postoperative week, and despite early ambulation five of our fourteen patients presented pulmonary symptoms. In two there was congestion at the base without typical roentgenographic signs of atelectasis; in three we believe that a small pulmonary infarct occurred but recovery was rapid and there was no definite proof that this was the case.

Necrosis of the skin adjacent to the incision particularly involving the posterior flap is understandable when one realizes the size and texture of the flap. It frequently is thin owing to the necessity for removal of the gluteal muscles which may be invaded by the tumor, and the thinner the flap the greater likelihood there is of necrosis which appears chiefly in the mid-portion of the incision. Fortunately none of this series had an extensive degree of necrosis but in five there was a limited area, three of which required skin grafting after the necrotic tissue had separated. (Fig. 2B.) The surfaces requiring coverage ranged from 1 by 3 cm. to 4 by 5 cm. In none was it necessary to use grafts at the time of operation.

Persistent sinus and residual abscess is the second important complication. These appeared in the mid-portion of the wound after the suture line had apparently completely healed. They were accompanied by practically no symptoms and often at first showed very little drainage which usually was not purulent.

Nine of our fourteen patients had persistent sinuses lasting from one to three months; two of these were reoperated upon for abscess, both on two occasions, and local recurrence probably explained the failure of normal wound healing. There were no operative deaths. One patient was discharged from the hospital on the seventeenth postoperative day.

CASE REPORTS

CASE 1. M. D., female, aged forty-eight years, was admitted to Memorial Hospital on October 29, 1946, with a painful, slightly tender swelling of the right upper thigh of three months' duration. One and one-half years previously she had complained of pain in the right knee which caused her to limp and she noticed that her right leg was smaller than the left. She was treated by several doctors for "arthritis" and "neuritis." A roentgenogram taken just prior to admission revealed a tumor of the femur. At this time the patient slipped on the stairs striking on her right knee and sustaining a pathologic fracture. She had lost 20 pounds in weight in one year.

Physical examination on admission revealed the right leg to be swollen to about twice the size of the left. There was pitting edema of the foot and ankle and extreme tenderness on motion of the knee and hip. A large, firm tumor mass was palpable throughout the upper two-thirds of the right thigh.

Roentgenograms of the femur revealed a large, soft tissue shadow surrounding the upper third of the femur. From the intertrochanteric line distally for a distance of 15 cm. the bone showed malignant features with areas of cystic, destructive and productive changes. There was a pathologic fracture through the center of the bone tumor. The roentgenologist believed the findings to be consistent with a diagnosis of osteogenic sarcoma.

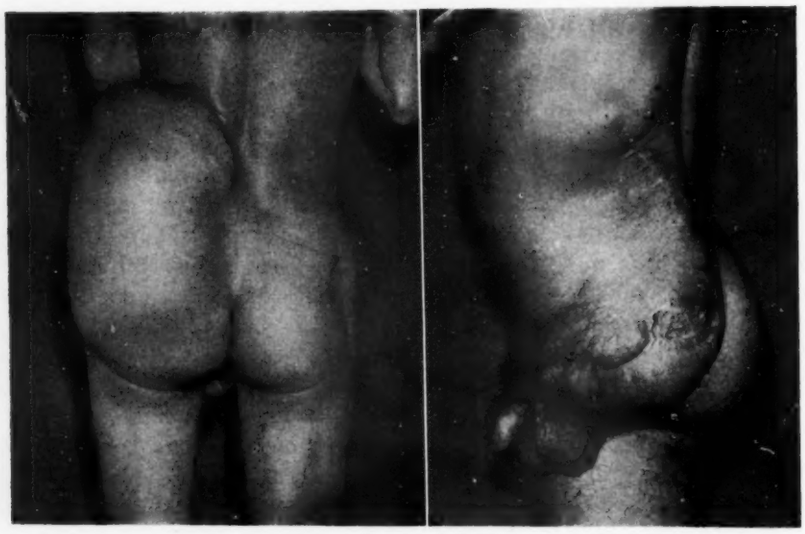
Blood studies showed the following: hemoglobin 10.6 gm., serum calcium 10.3 mg. per cent, alkaline phosphatase 4.8 units and serum inorganic phosphorus 3.68 mg. per cent.

An aspiration biopsy was done on October 23, 1946, and the report was osteogenic sarcoma.

Owing to the extent of the disease a hip disarticulation was regarded as obviously inadequate, so on November 11, 1946, under gas-oxygen-ether anesthesia a hemipelvectomy was performed. Examination of the amputated extremity revealed the tumor to have extended up into the head of the femur, with a thin layer of cartilaginous tissue separating the tumor from the acetabulum. Histologically, the tumor proved to be a chondrosarcoma which we believe was secondary to a pre-existing central chondroma. There were several large lymph nodes in the inguinal and iliac regions but these contained no tumor.

The first dressing was done on the second postoperative day and the patient was out of bed on the ninth day. The only postoperative complication was an abscess in the wound which required incision and drainage on December 16, 1946. At the time of her discharge from the hospital, January 13, 1947 (the seventy-fourth hospital day) the wound had completely healed. When last seen in August, 1950, the patient was in excellent condition with no evidence of recurrence or metastasis.

CASE 11. M. Y., a forty-eight year old white male, was first hospitalized in November, 1944,



2A 2B

FIG. 2. Case III. A, massive low grade chondrosarcoma of left ilium; pathologic diagnosis was chondroma but patient succumbed to pulmonary metastases twenty-six months after operation; B, appearance of healed wound four months after operation. Note small area where necrosis of flap required skin grafting.

because of pain and swelling about the right thigh. On November 17, 1944, an incisional biopsy was done and a diagnosis of chondrosarcoma of the femur was established. On December 8, 1944, a wide local resection of the upper part of the right femur was carried out and a fibular graft inserted into the ischium and distal end of the femur in an attempt to obtain an ischiofemoral arthrodesis. The graft slipped from the ischium postoperatively and on December 20, 1944, an attempt was made to replace it. An ischiofemoral pseudarthrosis followed. The patient was able to walk with a stiff hip and returned to work as an elevator operator in November, 1945. He had little discomfort until November, 1946, when there was a reappearance of pain, swelling and redness in the operative area of the right hip. The patient was again hospitalized on January 2, 1947, because of increase in pain and size of the mass about the right hip.

Examination on admission revealed an area of reddening 12 cm. in diameter with marked induration about the right hip with exquisite tenderness on palpation. The induration extended from just below the crest of the ilium to the middle third of the thigh. There was a three-inch shortening of the right leg. A roentgenogram of the hip revealed no change in the bony structure but it did outline an enormous soft tissue mass extending laterally from the hip joint to the skin. The clinical diagnosis was recurrent osteogenic sarcoma.

On January 21, 1947, a hemipelvectomy was performed. The patient withstood the procedure very well. Examination of the amputated extremity revealed a large, recurrent, anaplastic osteogenic sarcoma involving the upper part of the thigh with extension into the vastus lateralis and gluteal muscles. There was local metastasis to the inguinal lymph nodes and metastatic invasion of the femoral vein with mural tumor thrombi.

On the second postoperative day his red blood count had dropped to 2,200,000 and hemoglobin to 9 gm. The Wangensteen suction was removed and the patient was started on oral feedings. By the twelfth postoperative day he was getting about on a walker. He was discharged on crutches. At this time he was free of pain, was able to sit down and could manage stairs with the aid of crutches.

Because of the evidence of spread into the veins at the operative site, the ultimate prognosis was believed to be poor. On June 24, 1947, the patient died with recurrence in the stump and pulmonary metastases.

CASE III. B. L., a male aged thirty-eight years, was admitted to Memorial Hospital with a painless enlargement of the left hip (Fig. 2A) noticed three years previously. Six months before entry a partial left foot drop was noted.

The pain was minimal. There was no history of trauma. Sections from an incisional biopsy performed at another hospital were examined by our pathologist and reported as chondroma.

Physical examination revealed an extensive tumor mass which involved the left gluteal region. There were 4 cm. of atrophy of the left thigh and 3 cm. of the left calf. There was weakness in dorsi and plantar flexion of the foot. The hip could be flexed to 20 per cent, abducted to 40 per cent and rotated to 20 per cent of normal range. Roentgenograms revealed a large cartilage tumor originating from the upper left ilium, measuring 30 by 25 by 20 cm. and extending to the midline. The main portion of the tumor extended to the left sacroiliac joint. There was no evidence of pulmonary metastasis.

A diagnosis of chondrosarcoma of the left ilium was made by the roentgenologist.

The patient's hemoglobin, which was 41 per cent on admission, was brought up by multiple blood transfusions to 94 per cent. On April 29, 1947, under gas-oxygen-ether anesthesia a left hemipelvectomy was performed. The histologic report was osteochondroma. Tissue phosphatase studies revealed an alkaline phosphatase of 0.04 unit/gm. The immediate postoperative course was uneventful save for a sloughing of a 7 by 10 cm. portion of the anterior skin flap. This was covered with pinch grafts on June 26, 1947. The first dressing was done on the seventh postoperative day and the patient was out of bed on the same day. At the time of his discharge on July 7, 1947, the wound was almost entirely healed except for a small granulating area. (Fig. 2B.)

He remained free of disease until September, 1948, when he began to have pain in the scar area adjacent to the site of resection. Roentgenograms of the pelvis showed tumor involvement at the left border of the sacrum, and a chest film revealed a rounded homogenous density above the right dome of the diaphragm. The patient's course was steadily downhill until death took place on June 22, 1949.

CASE IV. G. V., a sixty-one year old male, was admitted to Memorial Hospital on March 4, 1948, because of pain in his amputation stump. At the age of forty-six he had been operated upon by one of us at another hospital for what proved to be, histologically, a "low-grade chondromyxosarcoma, probably originating in a degenerating central chondroma" of the lower left femur. Symptoms of pain and swelling in the left knee had persisted over a period of three years. A thigh amputation at a level of 28 cm. below the anterior superior spine had been performed on November 6, 1933. He remained well until nine months prior to admission to Memorial Hospital when he began to have pain in the buttock radiating to the amputation stump. There was a loss of 12 pounds in weight.

Physical examination revealed an area of swelling in the anterolateral aspect of the stump over the greater trochanter region, approximately 11 cm. in diameter. There were also signs of moderately advanced arteriosclerotic heart disease.

Roentgenographic studies of the pelvis disclosed destruction of the left ilium and left pubis with findings suggestive of cancer metastases to the right ilium and the descending ramus of the left ischium. Calcification was present in chondromatous elements of the bone in the left ilium, left femur and possibly the upper end of the right femur. There was no evidence of metastases in the chest nor residual disease in the amputation stump.

Aspiration of the swelling in the gluteal region revealed chondromyxosarcoma of low-grade.

Because of a slight fever preoperative chemotherapy was employed in addition to preoperative digitalis and quinidine. On March 12, 1948, under gas-oxygen-ether anesthesia a left hemipelvectomy was performed. The procedure lasted three hours during which period 2 L. of blood and ½ L. of normal saline were given intravenously. Grossly the tumor measured 15 by 10 by 7 cm. and was attached to the entire posterior surface of the ilium, extending down the crest to the ischial tuberosity.

The pathologist reported low-grade chondrosarcoma with tumor present to the line of incision. The decalcified specimens disclosed chondroma in the femur and low-grade chondrosarcoma in the acetabular region.

Except for a high fever for three days with a demonstrable suspicious area consistent with atelectasis in the right lung base, the immediate postoperative course was satisfactory. The patient was out of bed on the third postoperative day sitting in a chair and the first dressing was done on the fourth postoperative day. He was discharged on the seventeenth postoperative day at which time the wound had healed

FIG. 3. Case v. Type of prosthesis used successfully in four patients following hemipelvectomy.

except for a small amount of serous drainage from the lower angle.

He has remained free of his original disease but had a neurosurgical operation performed at the Hospital for Special Surgery on October 31, 1949, for evacuation of an old subdural hematoma which was aggravated by a fall sustained a week previously. He is now in a mental hospital but without any evidence of a local recurrence or pulmonary metastases.

CASE V. J. G., a forty-eight year old male, was admitted to Memorial Hospital on June 7, 1948, with a three-months' history of intermittent limping and pain in the right hip. Similar symptoms had developed on the left side also but disappeared after a few days. Physical examination was essentially negative. However, roentgenograms of the pelvis revealed a 5 cm. area of bone destruction in the right ilium just above the acetabulum, which was interpreted by the roentgenologist as an osteogenic sarcoma of the right ilium. There was no evidence of disease in the lungs and blood studies were normal.

Two aspiration biopsies yielded only a few cells suggestive of plasma cells. A sternal marrow aspiration was negative. An open biopsy of the ilium disclosed one area of "atypical endochondral ossification which may well represent a portion of a cartilaginous tumor. Coupled with the radiographic findings, the most likely diagnosis is osteogenic sarcoma."

In view of the apprehension of the patient and before all the reports were completed, roentgen therapy was started; 1,200 r were administered to the right ilium through each of four portals. The patient became asymptomatic.

Meanwhile the report of malignant tumor was received. Consequently on July 12, 1948, under gas-oxygen-ether anesthesia a right hemipelvectomy was performed; 2,000 cc. of blood were used. The tumor at no time was exposed. Grossly, the pathologist described it as located in the anterior portion of and embracing both sides of the ilium. It measured 3 to 4 cm. in thickness, 10 cm. in width and had a greyish-white, mottled, cut surface. Histologically, it was regarded as chondrosarcoma. The decalcified specimen also showed vascular invasion by the tumor.

The immediate postoperative course was not remarkable. The first dressing was done on the 5th day, the patient was up on crutches on the 7th day, and all sutures were removed on the twelfth postoperative day. He was discharged on the seventeenth postoperative day with a healed clean wound.

Three months after the operation the patient was walking reasonably well and could stand "for hours" on an artificial limb. (Fig. 3.) He has continued in excellent health, and has kept exceedingly active in his occupation as a liquor salesman, proprietor of a bar and grill and a leader and violinist in an orchestra. He was last seen on November 14, 1950, without evidence of recurrence or metastasis.

CASE VI. L. G., a forty year old male, entered Memorial Hospital on October 16, 1944, complaining of a dull pain in the right thigh, of two years' duration. During the second year the patient had been unable to

bend his knee or to lie on his right side. Physical examination revealed limitation of flexion of the right hip, but there was no palpable tumor. The knee could be fully flexed and there was no other significant abnormality. Blood chemistry studies were within normal limits. A roentgenogram, however, revealed a large multicystic-appearing area of bone destruction in the proximal end of the shaft of the right femur which was diagnosed as a chondromatous tumor. (Fig. 4A.) A curettage was performed on November 6, 1944, and the histologic diagnosis was chondroma.

The patient remained apparently symptom-free until May 22, 1946, when there was a suggestion of a recurrence in the region of the lesser trochanter. In January, 1947, he began to have transitory pain in the right leg, and in April, 1947, roentgenograms indicated progression in the size of the osteolytic areas. The patient was readmitted a few days later and physical examination revealed 30 degrees limitation in flexion of the right hip. Under gas-oxygen-ether anesthesia the tumor was again curetted and a bone graft taken from the tibia was introduced. The leg was placed in a hip spica and the patient was discharged several weeks later. In July, 1947, he was fitted with a walking Thomas caliper. Periodic roentgenograms revealed slow callus formation. Weight-bearing was begun on December 10, 1947, eight months after the operation. The patient resumed his former job as assemblyman in February, 1948.

He remained in good health until November, 1948, when he began to experience severe pain but of a different nature from that complained of previously. The thigh increased rapidly in size; and while roentgenograms of the hip showed little change, it was our clinical impression that the tumor had become malignant. (Fig. 4B.) At the time of the third hospital admission the swelling in the upper thigh was described as "the size of a basketball," firm and non-tender. (Fig. 4C.)

On December 20, 1948, under gas-oxygen-ether anesthesia a right hemipelvectomy was performed; 2,500 cc. of whole blood were used. Grossly the large, greatly lobulated tumor measuring 23 by 15 cm. surrounded the femur and invaded the central portion as well. (Fig. 4D.) Histologically, the tumor proved to be chondrosarcoma. The external iliac, femoral, inguinal and iliac nodes showed no metastases. The tumor tissue disclosed essentially no phosphatase activity, either acid or alkaline. The postoperative course was smooth. Wangensteen gastric suction was removed on the third day and tidal drainage of the bladder on the fourth postoperative day. By this time the patient walked with the aid of crutches. (Fig. 4E.) Drains which had been placed at either angle of the wound were shortened on the fourth day and were finally removed on the eleventh postoperative day. Frequent dressings with 2 per cent acetic acid successfully combatted a mild Bacillus pyocyaneus infection in the wound. The patient was discharged on the twenty-sixth postoperative day at which time the wound had healed per primam except for a central 4 by 1½ cm. defect which gradually closed by the end of the second postoperative month. He returned to his regular job in the second weeek of April, 1949, and has been well ever since. He has been fitted with a prosthesis and walks now with the aid of a cane. There is no evidence of disease two years after operation.

CASE VII. G. S., a forty-six year old married female, was admitted to Memorial Hospital on March 10, 1949, with a two and one-half-months' history of pain in her left hip radiating down her left leg to the knee which, despite diathermy, had persisted and had soon involved the ankle as well. The roentgenographic and open biopsy findings had prompted her physician to refer her to Memorial Hospital.

Positive physical findings were limited to her left hip, the site of the previous biopsy. There was weakness of the quadriceps with poor flexion of the leg. No other neurologic abnormalities were apparent.

Roentgenographic examination of the pelvis disclosed an area of bone destruction, about 2 inches in diameter, involving the left ilium, located adjacent to and just above the acetabulum. Films of the skull and chest revealed no abnormalities. The submitted section of the biopsy were interpreted by the Memorial Hospital pathologist as "suggestive of osteogenic sarcoma superimposed on an old chondroma."

Because of secondary wound sepsis of the previous biopsy site a left hemipelvectomy under gas-oxygen-ether anesthesia was deferred until March 28, 1949; 3,000 cc. of blood were used and the patient withstood the operation well. The tumor measured 9 by 9 by 2.5 cm., was fairly well encapsulated, lobulated and

4A 4B 4C

FIG. 4. Case VI. A, Roentgenographic appearance of original lesion on October 18, 1944, just prior to first operation at which time the pathologist reported central chondroma; B, roentgenographic appearance on November 17, 1948, just prior to hemipelvectomy showing bulky recurrence after two attempts to control disease by curettage and bone grafts; C, photograph five days before hemipelvectomy showing involvement of entire hip region and thigh.

occupied the inner surface of the ilium. It invaded but did not penetrate the acetabulum. The bulk of the tumor showed various degrees of degenerative changes from necrosis and hemorrhage. It was diagnosed histologically as an osteogenic chondrosarcoma with invasion of skeletal muscle. There was no evidence of disease in the lymph nodes. The patient was out of bed on the sixth postoperative day and the first dressing was done on the following day. Except for minor wound sepsis the patient made a good recovery and was discharged with the wound practically healed on May 12, 1949.

Owing to a persistent sinus tract, she was readmitted to Memorial Hospital on June 2, 1949, and two weeks later was reoperated upon to obtain better drainage of the sinus tract which led down to some heavy silk ligatures. Again on July 25, 1949, another incision was made in a portion of the scar of the original operation but no pus was encountered. During July, August and September it became increasingly apparent that there was a recurrence in the region of the sacrum contiguous to the portion of the ilium in which the tumor had been situated. A chest film, however, was negative. Despite frequent irrigations and dressings the sinus tract failed to close and subsequent examination of the discharge from the wound showed recurrent tumor. The patient was transferred to a home for terminal care on October 12, 1949, and died on December 30, 1949, with evidence of local recurrence but without signs of pulmonary metastases.

CASE VIII. H. I., a forty-two year old mechanical engineer, was admitted to Memorial Hospital on June 12, 1949, because of a painful, useless, left leg of four weeks' duration. He had had difficulty with the left hip since striking it in a fall from a scaffold six months previously. For five months weight-bearing on the left leg had been difficult because of pain. Roentgenographic examination revealed a destructive lesion in the pubis; this was biopsied in an outside hospital. On reviewing the sections our pathologists diagnosed the lesion as an osteogenic spindle cell fibrosarcoma.

Physical examination revealed enlargement of the entire upper thigh; the site of the previous biopsy was somewhat tender and erythematous. Movement of the left lower extremity was accompanied by exquisite pain. Blood studies were normal with the exception of a slightly elevated alkaline phosphatase of 5.7 units/100 cc.

Roentgenographic examination of the left hip disclosed an irregular area of bone destruction at the acetabulum involving the proximal

FIG. 4. D, gross specimen; microscopic diagnosis was chondrosarcoma.

portion of the superior pubic ramus for a distance of about 2 cm. There was no evidence of lung metastasis.

On June 21, 1949, under gas-oxygen-ether anesthesia a left hemipelvectomy was performed; 2,500 cc. of whole blood was used. The patient was out of bed on the second postoperative day and the first dressing was done on the sixth day. Postoperative wound sepsis, which developed, was treated with parenteral penicillin and wet dressings. A roentgenogram of the chest made on August 12, 1949, showed widespread pulmonary metastases. After subsidence of fever and disappearance of transitory, unexplained jaudice, the patient was finally discharged on August 20, 1949.

At the time of the operation the tumor was exposed at one point where it grew into the ramus of the pubis and this was accidentally cut into. Approximately ½ cc. of tumor tissue was expressed and immediately washed out as thoroughly as possible. The symphysis pubis and sacroiliac articulation margins were free of disease. The bulk of the tumor measured about 8 by 4.5 cm. and involved the ramus of

FIG. 4. E, roentgenogram ten days postoperatively.

the pubis, the acetabulum and surrounding muscle. It was diagnosed on histologic examination as a medullary spindle cell osteogenic sarcoma. The patient died at home on September 9, 1949.

CASE IX. J. T., a thirty-seven year old male, entered Memorial Hospital on July 25, 1949. Since his grammar school days the patient had noticed an asymptomatic mass in the left lower abdomen which, however, did not prevent him from qualifying for insurance in February, 1949. A few weeks after an accident in August, 1948, when he twisted his trunk, the patient noticed pain in the left thigh. This stabbing, intermittent pain was investigated in another hospital where, in November, 1948, an operation was performed which allegedly removed 80 per cent of the tumor of the left ilium. Submitted sections revealed chiefly chondroma and osteochondroma with areas of low-grade chondrosarcoma, and the patient was referred to Memorial Hospital for further treatment.

Physical examination disclosed a palpable tumor in the left lower quadrant which almost filled this area. It was fixed, non-tender and had an irregular surface contiguous with the left ilium. It also could be felt by digital examination as a hard, bony mass on the left lateral wall of the rectum. Several discrete rounded masses were palpable in the tissues of the abdominal wall near the inguinal ligament.

A 15 cm. well healed incisional scar was also present in the left inguinal region. Blood studies were within normal limits.

Roentgenograms showed a 7 cm. area of irregular bone destruction arising from the anterior surface of the left ilium and overlying the left sacroiliac joint. A film taken eight months earlier revealed that the tumor had increased by one-third in size.

A pyelogram disclosed medial displacement of the left lower ureter to the midline.

On July 28, 1949, under gas-oxygen-ether anesthesia a left hemipelvectomy was performed; 2,500 cc. of blood were used. Owing to the extent and location of the tumor and the fact that it was recurrent from a previous operation, the procedure proved to be a difficult one. The abdominal wall was the seat of several local recurrences presumably from implants. Grossly the disease was completely extirpated. The sacroiliac disarticulation could not be performed anteriorly owing to the overhang of the tumor, and the posterior approach was used instead. There was more than the usual blood loss, especially from the venous plexus around the symphysis pubis.

Pathologically, the left pelvic bone measured 24 by 18 by 16 cm. and was greatly distorted by a hard, firm, fixed tumor which was well covered by normal appearing muscle. The tumor arose mostly from the medial aspect of the left ilium and medially replaced the iliac fossa; it extended anterosuperiorly to the iliac crest, inferiorly to the antero-inferior iliac spine and postero-inferiorly into the body of the ischium completely obliterating the greater ischiatic notch. The sciatic nerve transversed the mass and was displaced medially. The resection margins were clear of disease. Histologically, the tumor proved to be chondrosarcoma.

Save for a wound which healed by secondary intention in two small areas, the postoperative course was not remarkable. The first dressing was done on the third postoperative day and the patient was out of bed on the same day. He was discharged from the hospital on September 2, 1949 (thirty-sixth postoperative day). He was seen about one year later, September 19, 1950, in good general condition; but by January 3, 1951, he showed definite evidence of pulmonary metastases.

CASE X. N. G., a forty-nine year old dentist was admitted to Memorial Hospital on August 24, 1949, because of a drawing sensation in the right scrotum of four months' duration; this sensation gradually became painful and led to the discovery of a lump in the right ischial tuberosity.

Physical examination revealed a stony hard enlargement of the right ischial tuberosity which extended up along the midline of the perineum and could be felt internally on rectal examination to press upon the rectal ampulla. A finger could be passed above the mass high in the rectum. One large 2 by 2 cm. firm lymph node was palpable in the right groin. Roentgenograms of the pelvis disclosed irregular areas of destruction involving the symphysis, the inferior ramus of the right pubis and the inferior ramus of the right ischium. Irregular areas of rarefaction were also noticed in the superior border of the right ischium in the ascending portion.

On August 29, 1949, a right hemipelvectomy was performed under endotracheal intubation and gas-oxygen-ether anesthesia; 2,000 cc. of whole blood were used.

The pathologic examination revealed grossly a 9 cm. tumor mass which almost completely replaced the ascending ramus of the right pubis and filled the obturator fossa. The mass bulged upward in the adductor canal for a distance of 4 cm. Microscopic diagnosis was osteogenic sarcoma with metastasis to one inguinal node and invasion into the veins. The patient was out of bed on the third postoperative day and the first dressing was done on the seventh postoperative day. The immediate course was complicated by wound infection which, at the end of the second postoperative week, discharged 40 cc. of purulent material. Because of bladder dysfunction a Foley catheter was placed into the bladder and was still there when the patient was discharged October 5, 1949.

On November 7, 1949, the patient was readmitted to Memorial Hospital because of pain in the right upper extremity of four weeks' duration, mental confusion and slurring of speech of two weeks' duration. Roentgenograms now showed a radiolucent area in the intertrochanteric region of the left femur, first noticed October 5th, which had now become more prominent and was interpreted as metastasis. The wound was biopsied by aspiration and the pathologist reported osteogenic sarcoma. The patient was given nitrogen mustard and compound SK 1133, but in spite of all

supportive treatment as well as chemotherapy, his course continued downhill. A roentgenogram on December 8, 1949, showed the recurrent tumor of the right side and progression of the osteolytic lesion into the left trochanteric region. The chest film, however, remained negative. The patient finally died on December 10, 1949. Permission for postmortem was not granted. There was evidence of multiple soft part metastases with signs of brain involvement but no clinical nor roentgenographic evidence of pulmonary invasion.

Case xi. J. C., a forty-five year old male, was admitted to Memorial Hospital on January 8, 1950, with a history of a dull aching pain in the region of the right hip first noticed in 1936 and which disappeared on external rotation of the lower extremity. During the following six years there was a gradual increase in discomfort. Roentgenograms made in 1942 were reported as showing "a spot in the hip but nothing to be concerned about." In May, 1944, after suffering severe pain especially on activity, the patient entered a mid-western hospital where an operation consisting of excision of a "non-malignant tumor of the ilium" was performed. There was marked improvement in symptoms for a year but the pain gradually recurred. In January, 1949, the patient noticed that the right buttock was larger than the left. He returned to the same hospital where roentgenograms were made which revealed a large recurrence of the tumor. Hemipelvectomy was recommended but refused.

Physical examination on admission to Memorial Hospital revealed a healed right-angled scar, 50 cm. in length, in the right gluteal region. This region was markedly enlarged with an underlying, indefinite, firm, nonmovable mass which bulged into the pelvis and the right lower quadrant and was associated with surprisingly little pain or tenderness.

Roentgenograms disclosed a sclerotic area of bone at the site of the previous excision above the greater sciatic notch, and an extensive soft tissue mass extending posteriorly to the ilium and medially into the pelvis, with small flecks of calcification. A film of the chest was reported as negative for metastasis.

On January 19, 1950, under gas-oxygen-ether anesthesia a right hemipelvectomy was performed. The operation technically was more difficult than were any of the preceding ten. Despite the fact that the internal iliac artery was temporarily occluded with a seraphin, there was an unusual amount of blood loss from the vessels in the region of the symphysis pubis and from those in the posterior flap. Thirteen pints of blood were administered during the course of the four and one-half-hour operation. The pathologic diagnosis was chondrosarcoma.

The patient was out of bed on the third postoperative day and the first dressing was done on the fifth day with removal of the bladder catheter. The wound healed with the exception of a small area in the mid-portion where undue tension produced a localized area of slough. Pinch grafts were applied to this area on the twentieth postoperative day. A very slight dressing was necessary for two months.

The patient was examined on September 27, 1950, and found to be in excellent condition without evidence of local recurrence or pulmonary metastases. Wearing a prosthesis, he is able to drive his car and to fly his own plane.

Case xii. W. K., a fifty-eight year old white male, was admitted to Memorial Hospital on April 6, 1950, with a diagnosis of fibrosarcoma of the right ilium made from a previous operative specimen. There was a history of two years' duration of mild pain in the inner right thigh which had increased in severity during the last six months. He had been unable to work for the past five months. He had had many treatments for "arthritis" of the hip, and on January 23, 1950, he had been admitted to an orthopedic institution where an exploration and biopsy of the right hip revealed only hemorrhage and inflammation. On March 24th a hipjoint fusion was performed, and a biopsy taken from the acetabular area at this time was diagnosed as fibrosarcoma; the patient was then referred to Memorial Hospital.

Roentgenograms disclosed "an invasive and destructive lesion arising in the acetabulum with involvement of the greater part of the floor. The process has penetrated deep into the substance of the ilium." There was no evidence of pulmonary metastasis and the local extent of the lesion was not beyond the prospect of successful hemipelvectomy.

Blood studies showed the following: hemoglobin 12.3 gm., serum calcium 10.4 mg. per

cent, alkaline phosphatase 5.4 and serum inorganic phosphorous 4.6 mg. per cent.

General clinical examination revealed no significant abnormality and the patient was considered a good operative risk.

On April 17, 1950, a right hemipelvectomy was performed under general anesthesia; the patient received 3,000 cc. of blood on the operating table. Examination of the amputated extremity revealed a spongy, cystic mass measuring about 5 by 6 cm. in the region of the right obturator fossa; gelatinous mucoid material exuded from this area and there was involvement of the acetabulum. These lesions were not visualized at operation. The pathologic report was osteogenic sarcoma.

Two pints of blood were given during the first five postoperative days. The first dressing was done on the fifth postoperative day. A short episode of atelectasis with bronchopneumonia intervened between the tenth and fifteenth postoperative days. The patient was discharged from the hospital on May 15, 1950, the fortieth hospital day, in excellent condition with his wound almost completely healed except for a small sinus with a moderate amount of discharge at the center of the wound. He returned for dressings in the outpatient department and it became obvious that a residual abscess was present beneath the skin flaps. Attempts to handle this on an ambulatory basis proving unsatisfactory, the patient was readmitted for incision and better drainage, which was carried out as follows: June 16th, incision of the multiple sinuses, and two weeks later partial closure of the wound. The drainage persisted because of a recurrence in the wound, and on July 28th a biopsy was done and reported as "sarcoma." In August a series of 250 Kv roentgen treatments were given to the stump. While this resulted in a reduction in size of the fungating tumor of the stump, the patient's course was steadily downhill and he died in a terminal care institution on October 1, 1950.

Case XIII. O. E., a twenty-eight year old male, was first seen at Memorial Hospital on August 11, 1948, with a tumor of the left iliac region. He stated that five years previously he had noticed pain in the region of the right hip when walking; one month later a lump appeared and grew slowly to its present size. He was seen by many doctors and in many institutions where several tests were made for various diseases but for three years no definite diagnosis was reached. Two years previously at the Institute of Radiology in Istambul (Turkey) a biopsy was performed and a diagnosis of "benign chondroma" was made. Roentgen therapy (2,800 r) was given through three portals to the external iliac fossa. The biopsy wound became infected and a general sepsis followed for two months. Since then he had gone through several periods of sepsis with drainage from the wound; once he was able to express some jelly-like material through the drainage site. He complained more of a sensation of itching than of pain.

Physical examination on admission to Memorial Hospital revealed a huge mass extending grossly over the right external iliac fossa and right hip, measuring 25 by 20 by 10 cm. On palpation it was firm and not tender. There were two draining sinuses. A skeletal survey revealed multiple cartilaginous exostoses, quite typical of the condition known as multiple hereditary deforming dyschondroplasia. Sections from a biopsy performed on admission were reported as "chondroma."

In view of the extensive involvement and because the condition was regarded as chondrosarcoma by the clinicians, despite the microscopic report, a hemipelvectomy was considered, but it was finally decided to attempt a local excision of a major portion of the ilium from which the tumor sprang. Accordingly on August 30, 1948, this procedure was carried out; it was possible to obtain complete closure of the wound. The postoperative course was uneventful and the patient was discharged on September 9, 1948; two weeks later his wound had completely healed. Pathologic examination of the specimen revealed only chondroma.

The patient returned to Turkey but four months later he began to notice pain in his hip, and a roentgenogram revealed a recurrence in the iliac fossa. After a lapse of almost two years from the date of his previous discharge he was readmitted to Memorial Hospital, October 11, 1950, at which time examination disclosed that the tumor had grown markedly in size and had extended widely. For the past two months he had suffered almost unbearable pain which required large doses of pantopon for control. At the time of readmission the mass measured approximately 30 cm. in diameter; it was irregular in outline and was more prominent on the posterior aspect of the

iliac area. It filled the left side of the pelvis so completely that on rectal examination it was felt to reach almost to the midline. Roentgenograms disclosed a large, recurrent, soft tissue mass; there was no involvement of the sacrum and no evidence of lung metastasis. An aspiration biopsy was reported as showing "chondroma, some areas suggestive of sarcoma."

On October 23, 1950, under gas-oxygen-ether anesthesia a left hemipelvectomy was performed. During the operation 5,000 cc. of whole blood was administered. The operative specimen, a huge mass measuring 33 by 32 by 27 cm. had extended beyond the midline but fortunately did not appear to have involved the sacrum. The pathologist reported "Chondrosarcoma, no node involvement, line of resection appears clear."

The patient was out of bed on the sixth postoperative day and the drains were removed on the eighth day; there was no necrosis of the flap. A small sinus with a slight amount of drainage persisted and was still present on his discharge from the hospital on the fiftieth postoperative day. This gradually cleared up and examination on January 31, 1951, showed the wound to be completely healed.

Case XIV. P. R., a forty-six year old male, was admitted to Memorial Hospital on November 1, 1950. Eighteen months prior thereto he had noticed a lump in the left hip associated with soreness in the same region. He was seen by a number of physicians and various forms of therapy were tried without relief. Eight months prior to admission a sharp pain was felt in the pelvis when he was in a sitting position. The mass increased slowly in size. On the assumption that he had an infection, streptomycin was given which produced no relief but disturbed his hearing. Two months before admission an x-ray film of the iliac bone was taken, and three weeks later an open biopsy was performed; the condition was diagnosed as chondroma.

Physical examination on admission disclosed a 15 cm. fusiform, firm mass beneath the scar of a previous operation on the anterior aspect of the left hip. There was no limitation of movement of the hipjoint. Roentgenograms revealed "an area of bone destruction involving the left pubis, acetabular region, and base of the left ilium. The over-all dimension of the mass is 10 cm. in diameter. There is no evidence of lung metastasis."

A biopsy performed on November 2, 1950, revealed chondrosarcoma; and four days later under gas-oxygen-ether anesthesia a left hemipelvectomy was performed; during the operation 300 cc. of whole blood was given. Examination of the gross specimen confirmed the clinical and roentgenographic findings; there was no extension of the disease into the pelvis; the margins appeared to be free of disease. Microscopic examination again revealed chondrosarcoma.

The patient had a relatively uneventful convalescence and was out of bed on the fifth postoperative day; the upper drain was removed on the sixth and the lower drain on the twelfth day; he was discharged to the care of his local doctor in good condition with an almost completely healed wound on the twenty-fourth postoperative day.

SUMMARY OF END RESULTS UP TO JANUARY 1, 1951

Of the fourteen patients comprising this series eleven had chondrosarcoma and three osteogenic sarcoma.

In the chondrosarcoma group eight are living and three are dead. The survival periods after operation in the living cases are: fifty months, thirty-three months, twenty-nine months, twenty-four months, seventeen months, eleven months, two and one-half months and two months, respectively; none showed any evidence of recurrence or metastases.

The survival periods in the three chondrosarcoma patients who died (Cases II, III, VII) were: twenty-six months, nine months and five months, respectively.

The results in the osteogenic group compare most unfavorably with those in the chondrosarcoma group. All three died (Cases VIII, X and XII) after a very short period of survival, i.e., five months, four and one-half months and three months.

CONCLUSIONS

From a study of these fourteen consecutive hemipelvectomies for malignant tumors of bone we believe that the following conclusions may be drawn:

1. Improvement in the preoperative preparation of the patient, the anesthesia and the operative technic, together with careful attention to blood volume and fluid balance, have greatly reduced the previously high operative

mortality of hemipelvectomy. There were no operative deaths in this series.

2. Necrosis of the skin flap and persistent sinus with residual abscess were the most frequent complications encountered, and were the principal causes for prolonged hospitalization in some of these cases.

3. The definitely more favorable prognosis of chondrosarcoma as compared with that of osteogenic sarcoma is emphasized.

4. In spite of the magnitude of the procedure and the great disability it causes in the early postoperative period, these patients tend to show a rapid recovery. Four of the fourteen patients are successfully wearing a prosthesis (Fig. 3) and have been able to resume gainful occupations and to lead normal social lives.

5. Of all varieties of primary malignant bone tumor involving the pelvic area or the proximal end of the femur, chondrosarcoma offers the strongest indication for hemipelvectomy based on its comparatively favorable prognosis; the same cannot be said of osteogenic sarcoma.

6. In view of the brief survival period that has followed hemipelvectomy performed for osteogenic sarcoma we question the wisdom of employing the procedure for this type of bone neoplasm.

7. Despite the fact that five-year survivals of cases of malignant tumors of bone subjected to hemipelvectomy may not often be obtained, the procedure is definitely worth while in selected cases for its relatively long-term palliation.

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OPERATIVE APPROACHES TO THE ANKLE JOINT*

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SURGICAL approach to the ankle joint or to the various osseous structures making up this joint has received little attention in the literature. This may be due to the fact that much of the structure is subcutaneous in location and direct approach to certain parts of it is easily gained without detailed anatomic consideration. This is not true of the other major joints of the body that have received surgical consideration. At one time such lack of information was permissible because the main surgical lesion to be dealt with in this region was one of infection and adequate drainage could be established with little fear of injury to anatomic parts. More recently the indications for approach to these parts have been much widened in scope and demand more detailed anatomic knowledge to avoid surgical misfortune. Exact anatomic knowledge by the surgeon will enable him to seek the proper approach which may be indicated by the surgical situation. This is especially true in fractures at the ankle joint in which it is now agreed that exact reposition is demanded, and by open operation if necessary.

ANATOMIC CONSIDERATIONS

The bony structures forming the ankle joint consist of the lower end of the tibia with its downward projecting medial malleolus and the malleolus of the fibula. (Fig. 1.) They are held together to form a mortise for the upper surface of the talus and its lateral and medial facets. The lateral malleolus tapers to a point about 1 cm. below the level of the medial malleolus and lies on a transverse plane about 1½ cm. behind the tip of the medial malleolus. Both are subcutaneous at the level of the ankle joint and form the most important landmarks in surgical consideration. The ankle is a true hinge joint consisting of the mortise formed by the tibia and fibula, receiving the body of the wedge-shaped talus. The articular surface of the talus, broader in front than behind, demands that there be some lateral separation of the two malleoli on extreme dorsiflexion if they are to embrace the talus in all positions of the joint. This is obtained by slight outward rotary movement of the lower end of the fibula and some upward shift of this bone together with a stretching and straightening of the ligaments of the lower tibiofibular syndesmosis and the interosseous membrane.[1] The tibiofibular syndesmosis or inferior tibiofibular articulation is the movable union between the medial surface of the lateral malleolus and the fibular depression in the lateral side of the tibia. Usually the bony surfaces opposed to one another are covered in their anterior portion by hyaline cartilage and, other times, only with periosteum. If covered by the former it is usually continuous with that of the ankle joint.

The synovial membrane of the joint invests the deep surface of the capsule and ligaments about the joint and usually sends a process between the lower ends of the tibia and fibula. The capsule of the joint is a relatively weak structure. It is attached proximally to the margins of the articular surfaces of the tibia and fibula and distally to the margin of the superior articular surface of the talus.

The stability of the ankle joint depends upon the shape of the mortise and the strong ligaments attached to the bones about it. The ligaments of the ankle may be conveniently divided into three groups, namely, (1) ligaments binding the tibia and fibula together at the distal articulation, (2) a medial group binding the tibia to the foot and (3) a lateral group binding the fibula to the foot.

The *interosseous ligament* consists of short, strong fibrous bands which pass between the opposing rough surfaces of the tibia and fibula. It is continuous above with the interosseous membrane. The inferior transverse ligament sometimes considered a part of the posterior lateral malleolar ligament passes transversely across the back of the joint from the lateral malleolus to the posterior border of the articular surface of the tibia almost as far as

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its malleolar process. This ligament projects below the margin of the bones and forms part of the articulating surface for the talus. The lateral malleolar ligament consists of two parts, anterior and posterior. The anterior is the flat, triangular band, narrower above than below, extending obliquely downward and lateralward between the margins of the tibia and fibula in front of the distal articulation. The posterior ligament, the smaller, with its origin from the tibia behind the fibular depression is directed obliquely downward to the posterior surface of the lateral malleolus. The inferior transverse tibiofibular ligament is sometimes considered a part of this ligament.

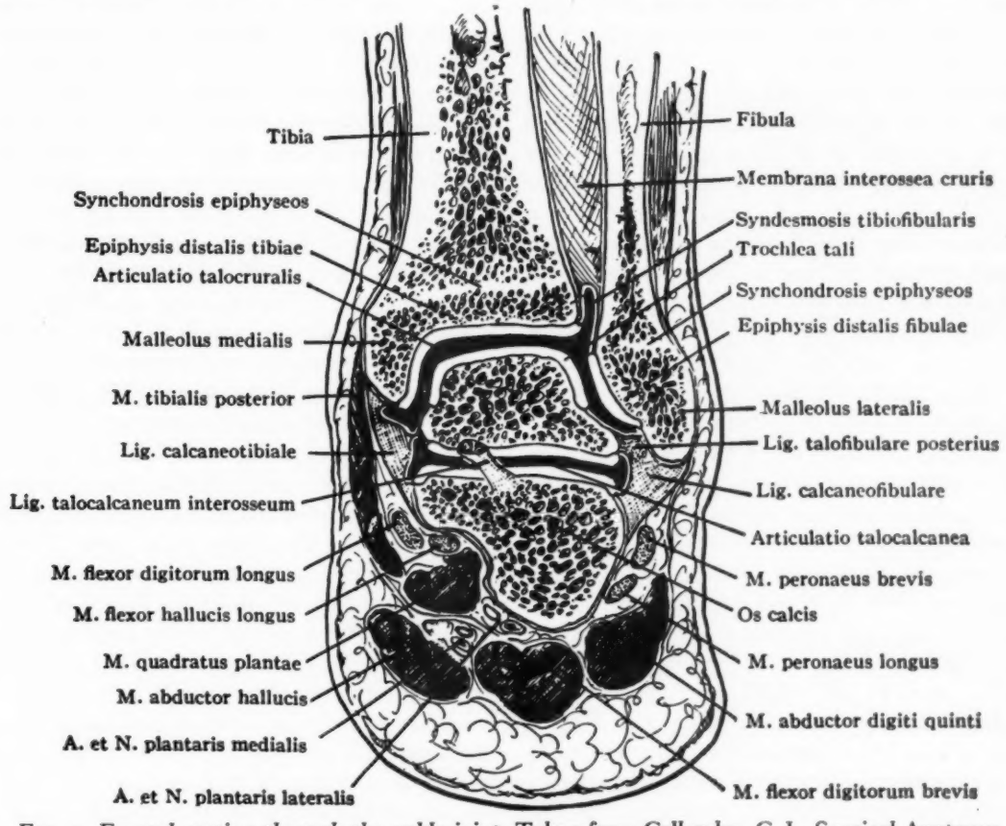

FIG. 1. Frontal section through the ankle joint. Taken from Callander, C. L. Surgical Anatomy, Figure 783, p. 783. Philadelphia, 1939. W. B. Saunders Co.

On the medial side the tibia is bound to the foot with the broad deltoid ligament. This has its origin on the medial surface of the malleolus of the tibia and spreads out to a broad attachment in the talus, os calcis and navicular bone. Anatomic divisions of this ligament are designated by the name of the bone to which they are attached. The posterior talotibial ligament is a thick, broad band that arises behind the tip of the malleolus and is attached to the talus close behind and below the medial facet of the trochlea of the talus; the anterior talotibial ligament is a short, narrow ligament that spreads from the anterior edge of the medial malleolus to the anterior portion of the medial facet of the trochlea.

The fibula is united to the foot through three ligaments. Anteriorly the anterior talofibular ligament spreads from the anterior surface of the lateral malleolus medially to the lateral surface of the neck of the talus. Posteriorly the posterior talofibular ligament rises behind the articular portion of the lateral malleolus and extends obliquely medialward and downward to the region of the lateral projection of the posterior process of the talus. The calcaneofibular ligament is a narrow, rounded cord extending from the tip of the malleolus downward and slightly backward to a tubercle on the lateral surface of the os calcis.

The fascia about the ankle is continuous with that of the leg. Thickened portions of it, called ligaments, prevent lateral or forward dis-

placement of tendons crossing the ankle joint. Anteriorly these fibrous bands are two in number. The proximal or transverse crural ligament is attached laterally to the lower end of the fibula and medially to the tibia. It binds down the tendons of the extensor digitorum longus, extensor hallucis longus, peroneus tertius and tibialis anterior, and also the anterior tibial vessels and deep peroneal nerve. The distal or cruciate crural ligament is a Y-shaped band placed in front of the ankle joint. The stem of the Y is attached laterally to the upper surface of the os calcis and is directed medially as a double layer, one layer passing in front of and the other behind the tendons of the peroneus tertius and extensor digitorum longus. At the medial border of the extensor digitorum longus the two layers fuse, forming a compartment in which these tendons are enclosed. The sheath then divides into the two limbs of the Y. The proximal end is directed medially to be attached to the tibial malleolus, passing over the extensor hallucis longus, the vessels and nerve, and enclosing the tibialis anterior posteriorly and anteriorly. The lower limb extends downward and medially to the medial border of the plantar aponeurosis, passing over the tendons of the extensor hallucis longus and tibialis anterior as well as the vessels and nerve.

On the medial side of the ankle the fascial thickening has been termed the laciniate ligament. This extends from the tibial malleolus above to the os calcis below. It forms separate tunnels with the bone underneath and allows the passage of the tendons of the posterior tibial muscle, the flexor digitorum longus, flexor hallucis longus and the posterior tibial vessels and nerve.

At the lateral side of the ankle there are two fascial thickenings which bind down the tendons of the peroneus longus and brevis. The proximal or superior retinaculum is attached above to the lateral malleolus and below to the lateral surface of the os calcis. The lower or inferior retinaculum is continuous with the cruciate crural ligament and is attached to the os calcis in front of and behind the peroneal tendons.

Posteriorly the ankle joint is crossed, in addition to the tendons enumerated, by the thick Achilles tendon. All the tendons crossing the ankle joint except this latter are enclosed for a part of their length in synovial sheaths.

The arteries maintain the following position at the ankle joint: Anteriorly the anterior tibial artery continues as the dorsalis pedis as it crosses the ankle joint. Immediately above the ankle joint it lies between the tibialis anterior and the extensor hallucis longus. At the ankle it is crossed from the lateral to the medial side by the tendon of the extensor hallucis longus and comes to lie between it and the medial tendon of the extensor digitorum longus. About 2 inches above the ankle joint two branches are given off. On the medial side the anterior medial malleolar artery usually passes behind the tendon of the extensor hallucis longus and tibialis anterior, to the medial side of the ankle and anastomoses with branches of the posterior tibial artery. The lateral malleolar artery passes beneath the tendons of the extensor digitorum longus and peroneus tertius, supplies the lateral side of the ankle and anastomoses with the perforating branch of the peroneal artery. Distal to the ankle joint the lateral tarsal artery arises from the dorsalis pedis as it crosses the navicular bone. It passes laterally directly upon the bone and, covered by the extensor digitorum brevis muscle, anastomoses with the anterior lateral malleolar artery and branches of the peroneal. Laterally and posteriorly the perforating branch of the peroneal artery pierces the interosseous membrane about 2 inches above the lateral malleolus to reach the front of the ankle where it anastomoses with the anterior lateral malleolar artery and continues in front of the distal tibiofibular joint. The lateral calcaneal artery is the terminal branch of the peroneal artery continuing, after the posterior lateral malleolar artery is given off, to the lateral side of the heel. Medially, behind the medial malleolus is the posterior tibial artery. It is covered only by skin and fascia and runs parallel with the tendons behind the malleolus. At the ankle a small branch, the posterior medial malleolar artery, is given off. It winds around the tibial malleolus and anastomoses with the anterior medial malleolar artery. Several large branches forming the medial calcaneal group are given off just before the artery divides. These branches pierce the laciniate ligament and are distributed behind the Achilles tendon and about the heel and muscles on the tibial side of the ankle. They anastomose with the peroneal and medial malleolar arteries. Anteriorly the great saphenous vein begins in front of the

medial malleolus as a continuation of the medial marginal veins of the foot.

The superficial nerves in relation to the ankle joint are three in number. The saphenous and superficial peroneal nerves are found anteriorly. The former crosses the ankle joint just in front of the medial malleolus. The latter divides above the ankle joint into the medial and intermediate dorsal cutaneous nerves. Posteriorly the sural nerve crosses the ankle joint between the lateral malleolus and os calcis, passing forward below the lateral malleolus onto the side of the foot.

The deep nerves are two in number. Anteriorly the deep peroneal crosses the ankle joint to the lateral side of the anterior tibial artery. Posteriorly the tibial nerve crosses the ankle in the interval between the medial malleolus and the os calcis where it divides beneath the laciniate ligament into the medial and lateral plantar nerves.

Various types of operations about the ankle joint have been described,[2–5] with no reference given to methods of approach to the particular structures involved. Apparently the method of approach seemed to the surgeon to be quite obvious and did not require detailed description. This is not always true, however, as certain surgical conditions may demand an approach through important anatomic structures.

ANTERIOR APPROACHES

No priority for the description of anterior approach to the ankle can be given. (Fig. 2.) Anterior approach is not described by Leveuf[6] or Kocher.[7] Campbell[8–10] describes an anterior approach or, more properly, an anterolateral approach. The incision begins over the anterolateral aspect of the leg medial to the fibula and 2 inches proximal to the ankle joint. The incision is carried distally over the joint and the anterolateral aspect of the body of the astragalus terminating at the external cuneiform bone or the base of the fourth metatarsal bone. The fascia and transverse crural and cruciate crural ligaments are incised down to the periosteum of the tibia and the capsule of the ankle joint. The anterior lateral malleolar and lateral tarsal arteries usually are divided by this dissection. The extensor digitorum brevis muscle is then separated in the direction of its fibers, the long extensor tendons are retracted medially with the dorsalis pedis artery and deep peroneal nerve and the capsule is incised revealing the ankle joint.

Through this incision it may be sometimes difficult to reach the articular surface between the medial malleolus and medial articular facet of the body of the astragalus. Approach to both

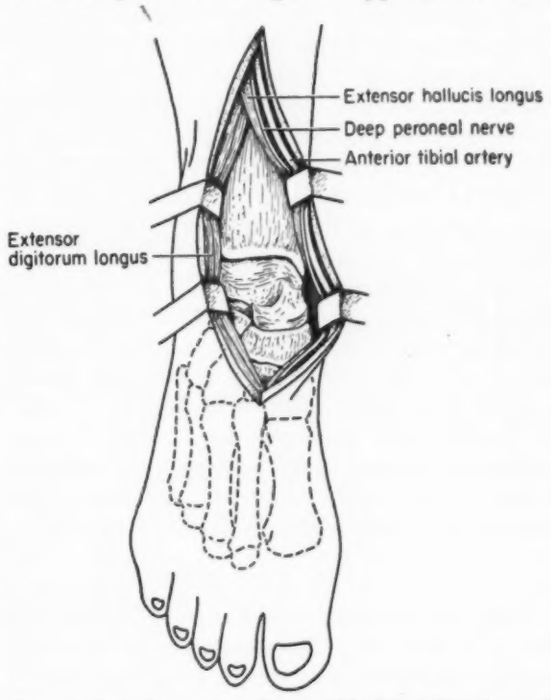

FIG. 2. Anterior approach to ankle joint. Tendons of the extensor hallucis longus and anterior tibial together with the neurovascular bundle retracted medially, tendons of the extensor digitorum longus retracted laterally.

malleoli through an anterior incision would seem to be best accomplished at the interval between the extensor hallucis and the extensor digitorum longus. This approach[11,12] has been described. The ankle joint is exposed through an anterior longitudinal incision midway between the malleoli. The tendons of the extensor digitorum longus are retracted laterally and those of the tibialis anterior and extensor hallucis longus together with the dorsalis pedis vessels and nerve are retracted medially. The periosteum of the tibia and the capsule of the ankle joint are divided longitudinally and reflected.

The length of the incision will vary with the surgical indication at hand. The fascia is divided in line with the skin incision and this will come down directly over the neurovascular bundle. This is carefully exposed and can be retracted medially after division of the anterior

lateral malleolar and lateral tarsal arteries. Incision through periosteum, capsule and synovium is then made in line with the skin incision and dissection to either side is accomplished subcapsularly and subperiosteally, exposing the full width of the ankle joint anteriorly.

Scaglietti[13] and Nicola[14] advise anterior approach to the ankle joint through the interval between the tibialis anterior tendon and the tendon of the extensor hallucis longus. The neurovascular bundle is taken laterally with the extensor tendons, the tibialis anterior tendon is drawn medially and the periosteum and capsule is divided in line with the skin incision.

The structures concerned in the anterior approach are: (1) skin and subcutaneous tissue, (2) dorsal medial branch of superficial peroneal nerve, (3) fascia including transverse crural and cruciate crural ligaments, (4) neurovascular bundle and (5) tendons of the extensor digitorum longus laterally, tendons of extensor hallucis and anterior tibial medially, joint capsule and synovium.

POSTERIOR APPROACHES

Posterior approach to the ankle joint and adjacent structures has been described with minor variations by many authors. Picot[15] advises operation for fractures of the posterior lip of the tibia when the fragment is large and displaced. He uses an incision that begins at the external border of the Achilles tendon, 10 to 12 cm. above the ankle joint. It is brought down the lateral border of the tendon and at the level of the malleolus is swung medially and posteriorly to 1 cm. behind the internal malleolus. The Achilles tendon is divided obliquely through an 8 cm. incision. The deep aponeurosis is then divided and the fibers of the flexor hallucis are separated from the fibula and retracted medially. The periosteum of the tibia is then divided and the fragment exposed.

Alglave[16] advises similar treatment for large displaced posterior lip fractures. An L-shaped incision is placed in the skin, attached along the medial surface, from above the lateral malleolus to a point below the medial malleolus. The tuberosity of the os calcis is exposed and divided with a Gigli saw. The flexor hallucis, the tibialis posterior and flexor digitorum longus are reflected to one side, the peroneals to the other and the fragment exposed. In closing, the tuberosity of the os calcis removed in the approach is fixed with one screw. Leveuf[6] advises similarly placed incisions for exposure of a posterior lip fracture. If the lateral malleolus is to be approached at the same time, the incision is made the shape of an L. The transverse lower portion crosses the tuberosity of the os calcis to end just below and behind the medial malleolus. If the lateral malleolus does not require exposure, an elliptic incision similarly placed is used. The tendo achillis is divided in both cases to approach the posterior fragment. The incision is never placed directly over the Achilles tendon. Gill[17] described a posterior approach for posterior bone block. The skin incision is made parallel to the Achilles tendon. The latter is exposed and divided in Z fashion. Incision is then made longitudinally through the underlying fat which is taken to each side to expose the posterior aspect of the ankle joint and the top of the os calcis. The ankle joint is opened. The foot is dorsiflexed to the limit. This brings the posterior portion of the articular surface of the astragalus into view.

Lurije[18] describes the posterior approach to the talocrural joint in work with cadavers. This incision begins 7 cm. above the lateral malleolus just lateral to the tendo achillis. It is then carried down to the tuberosity of the heel, around the heel to the medial side and can then be carried forward or up depending upon the surgical indication. The attachment of the tendo achillis to the heel is removed with a wedge of bone from the tuberosity, the entire flap is taken medially and the joint is entered through a longitudinal incision in the capsule and periosteum.

Lambotte[19] advises fixation and reduction of large posterior lip fractures. He describes the approach to the fracture as a posterior approach through a longitudinal incision behind the fibula. Apparently this is a straight incision with muscles retracted medially.

Campbell[10] describes a posterior incision 5 inches in length made along the posterior lateral border of the Achilles tendon down to the insertion of the tendon into the os calcis. The superficial and deep fasciae are divided, the Achilles tendon is lengthened by the Z plasty method or retracted and the fat and areolar tissue are incised on the posterior surface of the tibia in the interval between the flexor hallucis longus and peroneal tendons.

By retraction of the flexor hallucis longus tendon medially 1 inch of the lower end of the tibia, the posterior surface of the ankle joint, posterior extremity of the astragalus, subastragalar joint and posterior portion of the superior surface of the os calcis may be exposed. Henry[20] described a similar approach to the distal tibia.

The structures concerned in the posterior approach are: (1) skin and subcutaneous tissue, (2) sural nerve, (3) Achilles tendon, (4) flexor hallucis longus muscle, tendons of the tibialis posterior muscle and flexor digitorum longus, (5) peroneal artery and branches and (6) Posterior neurovascular bundle.

LATERAL APPROACHES

Direct approach to fractures of the lateral malleolus is possible by an incision placed directly over the fibula as it is entirely subcutaneous throughout the distal 7 inches of its length. The incision is usually curved anteriorly or posteriorly to afford better access to the anterior and posterior borders. (Fig. 3.)

Kocher[7] has described a lateral approach for exposure of the ankle joint. The incision begins about 10 cm. above the tip of the lateral malleolus just posterior to the fibula. The skin and fascia are divided while the external saphenous vein and nerve (sural) which lie immediately behind the incision are preserved. It is brought down posterior to the fibula curving around the malleolus. It terminates at the tendon of the peroneus tertius and avoids the musculocutaneous nerve (superficial peroneal). The sheaths of the peroneus longus and brevis are then exposed and slit upward behind the fibula as far as the upper end of the incision. The tendons have to be divided in some cases so as to afford more room but each is secured with silk in order to be sutured at a later stage. The periosteum is separated on the outer and lower aspect of the external malleolus and the joint opened into in front of it. The capsule is now detached along the outer surface of the astragalus exposing it as far as the internal malleolus, the extensor tendon being retracted upward, a similar method being adopted at the posterior surface of the fibula so as to leave the tendon sheaths of the peronei in relation to the periosteum. The foot is forcibly dislocated inward over the internal malleolus so that the upper surface of the astragalus looks downward and the sole of the foot upward.

Steindler[21] lists this incision as a very satisfactory approach to the ankle joint and prefers it to the other types of lateral approach. Goldthwaite[22] describes the lateral approach for

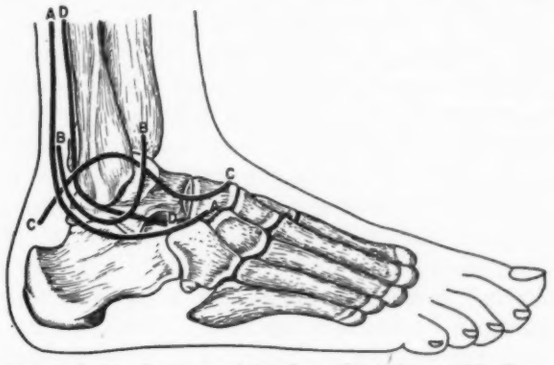

FIG. 3. Lateral approach to the ankle joint. A, Kocher; B, Goldthwaite; C, Sutherland and Rowe; D, Gatellier.

ankle fusion combined with fusion of the talocalcaneal joint: "A curved incision convex downward is made over the outer side of the foot and through this the tendons of the peroneus longus and brevis are cut, as are also the lateral ligaments (the calcaneo-astragaloid, the outer part of the astragalo-scaphoid and the middle fasciculus of the external lateral ligament of the ankle joint) so that the foot can be bent to the inside and disarticulated at the astragalo-calcaneo articulation. In this the astragalus remains attached to the tibia and the under surface is exposed so that it can be denuded of its cartilage, after which the same thing is done to the upper articular surface of the os calcis. The remainder of the lateral ankle ligament is then divided and the astragalus is disarticulated so that its upper surface is thoroughly exposed, as is also the tibial and fibular aspects of the ankle joint. The cartilage is then removed from all of these bones and the dissection is carried deeply enough so that fresh bone is exposed. As the bones are put together, the space between the malleoli and sides of astragalus are increased over the normal. To remedy this and to change the axis of the outer malleolus so that it may become a real support to the ankle and hold the astragalus in place, an oblique osteotomy of the fibula is performed, the section on the inner side extending into the upper part of the joint. The malleolus is then bent in so that its axis is vertical and it rests firmly against the

astragalus when that bone has been pressed against the inner malleolus."

Goldthwaite has described essentially the use of the fibula as a bone graft traversing the ankle joint, a procedure that has been recently popularized with some modification. Koenig and Schaffer[23] have described a similar approach in which the fibula is not osteotomized; but if preference is given to the medial approach, they advise osteotomy of the medial malleolus, swinging it down without detaching the deltoid ligament.

Leveuf[6] utilizes a lateral incision which begins in front of the fibula and swings posteriorly around the tip of the malleolus. Couvelaire, Baumann and Delinotte[24] describe a lateral incision for repair of malunited fractures of the ankle by excision of the astragalus and tibiocalcaneal fusion. The skin incision begins at the posterolateral border of the fibular shaft 10 cm. above the end of the malleolus. It is carried vertically downward to 1 cm. beyond the tip of the malleolus and carried forward on the dorsum of the foot in the direction of the scaphoid tubercle, stopping about the middle of the foot. The fascia is divided in the same line. The peroneal tendons are retracted posteriorly. The fibula is divided above the fracture and above the inferior tibiofibular articulation. The talofibular ligament is divided. The distal fragment of the fibula is completely freed by dividing the calcaneofibular ligament and the remainder of the joint capsule. The distal fibula is discarded. The talus is mobilized by dividing the medial ligament, the lower ligamentous attachments of the talus are divided and the bone removed. With the same skin incision the approach may be affected saving the lateral malleolus if this is desired. The peroneal tendons are retracted posteriorly. The lateral calcaneofibular ligament is divided and the lateral surface of the os calcis is stripped subperiostially so the foot can be inverted on its medial attachments. This is similar to the incision described previously by Whitman[25] for astragalectomy. "The line of incision begins at a point about an inch above the extremity of the external malleolus, midway between it and the achilles tendon, and is continued downward and forward about three-fourths of an inch below the malleolus over the dorsum of the foot to the external surface of the head of the astragalus."

Sutherland and Rowe[26] describe a lateral incision curved in an S shape beginning just behind and above the tip of the malleolus curving upward over the bone, downward in front and then carried forward and over the foot to the navicular tuberosity. The ankle joint is exposed by dividing the fibula above the tibiofibular joint and reflecting the distal fragment plantarly.

Traub[27] describes a lateral approach to the ankle joint that combines approach to the tarsal joints as well. With the ankle in extension the incision starts over the lateral aspect of the fibula between the peroneus brevis and extensor digitorum longus about 8 cm. above the tip of the external malleolus. From there it proceeds slightly backward to a point about 1 cm. behind the malleolus then curves forward to a point half way between the tip of the malleolus and the tuberosity of the fifth metacarpal and finally continues in a gentle curve across the dorsum of the foot, ending in a point a little beyond the highest prominence of the instep which corresponds to about the midpoint of the articulation of the first and second cuneiform process and the second metatarsal. The incision penetrates through the skin with its vessels and nerves. The skin flap is dissected back, leaving exposed the thin fascia covering the tendon sheaths and the fascial reinforcement. Division of the superior and inferior peroneal retinaculum and the lateral continuation of the cruciate frees the tendons of the peroneus longus and brevis. These tendons generally are best divided at this stage of the operation. The tendons of the extensor digitorum longus and hallucis with the cruciate ligament dissected off are retracted toward the medial line.

Gatellier[28,29] has described the approach for fracture of the posterior lip of the tibia through a laterally placed incision. The skin incision begins 12 cm. above the tip of the external malleolus, follows the posterior border of the fibula, curves a little more at the lower end and runs around the tip of the external malleolus. The edges of the incision are pulled back, exposing the external surface of the fibula and the fractured malleolus. Behind the bone the peroneal tendons in their sheaths can be seen. The sheath is sectioned about 2 mm. from the posterior border of the fibula. This section closely follows the skin incision and runs around the tip of the malleolus. The peroneal tendons are freed from their sheaths. The

peroneal tendons are then pulled forward in front of the fibula and are held there with a retractor. In order to perform this step well it is necessary to detach from the fibula the lower fibers of the peroneus brevis. The lower fibers of the flexor hallucis longus are then detached from the posterior surface of the fibula. If the anterior and posterior tibiofibular ligaments are still intact, they are sectioned. When the fibula is fractured, the external malleolus is turned around its tip from above downward. This manipulation is done without injury to the anterior and posterior talofibular ligaments or the cancaneofibular ligament. The Achilles tendon and the deep posterior muscles of the leg are held downward and backward with retractor; the peroneal muscles are pulled forward. The posterior and external surfaces of the lower end of the tibia are best exposed with the foot in extension and in varus.

Alldredge[30] has used this approach and advises it if open reduction of the posterior lip fracture is indicated.

Horwitz[31] advises a similarly planned incision for arthrodesis of the ankle joint. The skin incision runs along the posterior border of the lower 4 inches of the fibula to just below the tip of the external malleolus and swings forward to end over the cuboid bone. The peroneal tendons are exposed and retracted posteriorly or divided, the fibula is osteotomized about 7 cm. above the tip of the malleolus and this lower fragment is reflected laterally leaving only its posterior attachments intact. The ankle joint is further exposed, especially anteriorly, by additional soft tissue stripping.

Benavente[32] describes a similar lateral approach for arthroplasty of the ankle. A semicircular incision 10 cm. long is made through the skin and subcutaneous tissues with the external malleolus as the center. The tendons of the peroneus longus and brevis are separated from their sheaths and retracted. At a point about 3 cm. from the apex of the malleolus of the fibula a Gigli saw is introduced between the tibia and fibula and the fibula is then sawed through upward and outward, forming an oblique surface which will insure perfect bone coaptation when reunited after the operation. The malleolus is dissected downward, care being taken not to separate it from the external lateral ligament which by its insertion at its tip serves as a hinge to aid its downward rotation. The cut malleolus should be covered with a wet sponge while the operator proceeds to expose the entire external lateral surface of the tibial astragular synosteosis. All the tissues and tendons on the anterior surface of the articulation are separated subperiosteally and held with the aid of wide retractors until complete exposure of the anterior surface of the tibio astragalar articulation is obtained.

Adams[33] has advised lateral incision in arthrodesis of the ankle joint using the fibula as a graft, spanning the joint. An incision 5 inches in length is made over the lower third of the subcutaneous surface of the fibula. It is prolonged downward to a point ½ inch distal to the tip of the lateral malleolus. The fibula is exposed subperiosteally and is divided 3 to 4 inches from its lower end, exposing the ankle joint for removal of cartilage after stripping the ligamentous tissues from the lateral aspect of the lower half of the wound. The distal fragment of the fibula is removed and prepared for use as an onlay graft.

The anatomic structures involved in the lateral approach are: (1) skin and subcutaneous tissue, (2) superficial nerves, sural and superficial peroneal, (3) deep fascia including superior and inferior peroneal retinaculum and cruciate crural ligaments, (4) tendons of the peroneus longus and brevis behind the lateral malleolus, anterior to ankle joint, extensor digitorum longus and hallucis longus, and (5) anterior and posterior talofibular ligament, calcaneofibular ligament, interosseous ligament and joint capsule.

MEDIAL APPROACHES

Because of the attachments of the anterior and posterior tibial tendons the medial side of the ankle joint would seem to offer a less readily available approach than the lateral field. (Fig. 4.) As the bone is subcutaneous, direct approach is possible for open reduction of the fractured malleolus. Leveuf[6] advises a U-shaped short incision curved around the tip of the malleolus, the skin and subcutaneous flap reflected proximally. If possible the attachments of the deltoid ligament are preserved. Koenig and Schaeffer[23] advise medial approach for osteoplastic surgical exposure of the ankle joint. The incision begins about 2 cm. above and slightly behind the medial malleolus, and curves upward across the tibia and down the front and medially along the foot as far as the naviculocuneiform joint. The medial malleolus

is detached by osteotomy above, outward and downward. The medial ligament (deltoid) is not disturbed but the malleolus is swung downward as on a hinge exposing the medial surface and neck and head of the talus. The capsule is reflected from the front of the joint and posteriorly. The talus can then be swung outward. In closure the malleolus is reattached using some type of internal fixation.

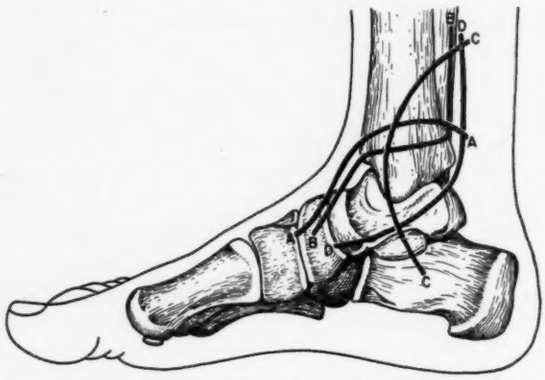

FIG. 4. Medial approach to the ankle joint. A, Koenig and Schaeffer; B, Couvelaire; C, authors' approach; D, Broomhead.

Couvelaire[24] advises a similar procedure with an incision placed somewhat differently. The skin incision is placed on the posteromedial border of the tibia beginning 12 cm. above the medial malleolus. It descends vertically to the level of the upper portion of the medial malleolus, forward across the base of the malleolus then is carried obliquely downward just past the scaphoid tubercle. Completed, the line of incision is the shape of a bayonnet. Tendons and the neurovascular bundle are retracted posteriorly and the medial malleolus divided with an osteotome. For arthrodesis of the ankle joint Anderson[35] advises removal of both malleoli through straight linear incisions.

Broomhead et al.[34] advises approach to the posterior lip fracture of the tibia through a medial incision. It is situated midway between the posterior border of the tibia and inner border of the tendo achillis and, passing below the internal malleolus to the inner margin of the foot, allows both internal and posterior malleoli to be reached. This latter is exposed by capsular and periosteal reflection retracting the tendons of the posterior tibial, flexor digitorum and hallucis together with the neurovascular bundle backward and medially.

One of the authors (E. L. R.) recommends a medial approach for open reduction of both medial malleolar and posterior lip fractures. (Fig. 5.) The incision begins 4 inches above and 1 inch behind the medial malleolus. It curves forward and downward across the middle of the malleolus and continues downward and backward for 1½ inches toward the heel. The medial malleolar fragment is exposed by periosteal reflection, the deltoid ligament being preserved.

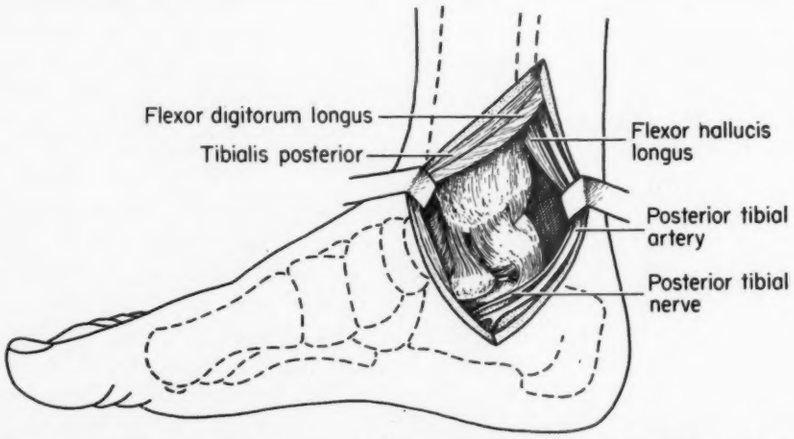

FIG. 5. Approach to posterior lip of tibia through medial incision. The tendons of the posterior tibial and the flexor digitorum longus are carried forward; the tendon of the flexor hallucis longus and the neurovascular bundle are retracted backward and laterally.

To expose the posterior tibial fragment the tendons of the tibialis posterior and the flexor digitorum longus are retracted medially and forward after longitudinal division of the laciniate ligament. The neurovascular bundle is carefully exposed and with the flexor hallucis

longus is retracted posteriorly and laterally to expose the fracture site.

The structures concerned in the medial approach are: (1) skin and subcutaneous tissue, (2) fascia and laciniate ligament, (3) tendons of tibialis posterior, flexor digitorum longus and flexor hallucis longus and (4) posterior neurovascular bundle.

INCISIONS FOR DRAINAGE OF ANKLE JOINT

With the modern use of antibiotics the indications for drainage of the ankle joint are not encountered as frequently as previously. Campbell[10] advises the use of any one of, or combination of, four incisions. One, the anterolateral incision is placed ½ inch medial to the external malleolus, the section carried down to fascia, joint capsule and synovium directly to the joint. Similar incisions may be placed posterolaterally, anterolaterally and posteromedially. The posteromedial incision requires that the tendon of the flexor hallucis longus be retracted medially and protection afforded the neurovascular bundle.

David[36] in cadaveric experiments showed that the best route for drainage is the posterior external incision. The incision is made in the posterior external aspect of the ankle joint 1½ cm. lateral to the Achilles tendon. It begins 5 cm. above the external malleolus and extends down to the os calcis following the anterior border for 1½ cm. The external saphenous nerve (sural) and vein are encountered and retracted posteriorly. A thick pad of fat is seen hugging the posterior ligament. This may be pressed down against the entrance to the subastragalar joint for protection. The ankle joint is entered above the shining cordlike posterior fasciculus of the external lateral ligament (talofibular ligament). It would seem that with the use of moderate antibiotics it would not be necessary to establish drainage as Reynolds[37,38] advised. He advised excision of the astragalus and drinage of the ankle through the space so created. The astragalus is approached through an incision parallel to the outer side of the extensor tendon made with the foot strongly adducted. The astragalus is removed through this incision and counterdrainage is established through incisions made behind on either side of the tendo achillis.

SUMMARY

A résumé of varied approaches to the ankle joint has been presented. The authors have not used all of them. Although personal preference has been given to certain ones of these, the purpose of this paper has been to review the anatomy and operative approaches to this joint and not advance one procedure over the other. It would seem well to realize that certain routes of approach can be best utilized under individual circumstances. When the surgeon has a clear understanding of the pathologic changes confronting him, he can then choose his method of approach.

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FAILURES IN SCREW FIXATION*

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THE use of screws through the lateral articulations to obtain lumbosacral fusion has been described.[1] Subsequent authors have commented on this type of fusion and submitted follow-up studies.[2] Since our incidence of pseudarthrosis at the Long Island College Hospital is greater than any heretofore recorded, we believe this article might constitute a contribution to the literature on the subject. We have records of sixteen screw fixations performed prior to 1950. Although since 1950 we have continued this method of fixation, complete postoperative evaluation of each case demanded at least twelve months of careful follow-up study. Such study was possible in only thirteen of sixteen cases.

TECHNIC

A routine subperiosteal approach to the spinous processes, laminas and the lateral articulations of L4, L5 and S1 was used. The posterior capsule of the articular facets is removed. Prior to this follow-up study it had been our technic to remove the spinous processes of L4, L5 and S1, but with our revised technic this procedure is now discarded. We did not destroy the articular cartilage between the facets as it was our impression that this cartilage is destroyed automatically under the influence of pressure, the presence of a foreign body; i.e., the screw, and the damage to the articular cartilage caused by the insertion of the screw. Using a sharply pointed wire a depression is made in the center of the posterior surface of the inferior facet of the vertebrae to be fused to avoid wandering of the drill point. A No. 9 drill point is used to drill the contiguous facets, exercising due care to maintain the drill point parallel to the inferior edge of the lamina. Vitallium® screws, ¾ inch long for the female, 1 inch long for the male, are inserted into the drill holes in the facets selected. From this point the routine Hibbs' technic of spinal fusion was used. Bone from the spinous processes and cortical bone strips from the posterior surface of the sacrum were used for bone grafts. Prior to 1950 the aforementioned technic was used, but careful follow-up dictated certain revisions.

The following changes were instituted, providing the object of the operative procedure is to fuse L4 to L5 and L5 to S1: The initial approach remains unchanged, but the articular cartilage of the facets is cauterized by the use of a flat cautery tip. The spinous processes, however, are left intact, but the supra- and interspinous ligaments are removed from the processes of L4, L5 and S1. With the processes intact, difficulty may be encountered in drilling the articular facets at the correct angle, but this is circumnavigated by the use of a long No. 9 drill point or by the use of a Kirschner wire of the same size. If the correct angle is still not obtainable, a small notch is made in the particular spinous process obstructing the insertion of the drill point. Screws are inserted as previously described and Hibbs' technic followed. The use of large quantities of cancellous bone we consider obligatory and this is obtained from the region of the posterosuperior iliac spine. Leaving the spinous processes intact creates a larger recipient site and a more solid fusion should result.

Postoperatively, a bedboard is inserted under a hard, thin mattress and the patient encouraged to move about freely. He is permitted out of bed on the sixth or seventh day postoperatively. If some type of support had been worn preoperatively, only then is a support continued. A distinct advantage of the screw fusion lies in the freedom from external fixation over long periods postoperatively.

Postoperative Complications. Although postoperative problems have presented themselves, they have been relatively few in number. In one patient mild thrombophlebitis developed which responded well to treatment. A second patient complained of bilateral hypesthesia, the etiology of which remains unknown, and continued for a period of two months. In

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1 2

FIG. 1. Lateral view showing screws in place; a pseudarthrosis is apparent and there has been absorption of the graft; this view is of the same patient as Figure 2.
FIG. 2. Oblique view of screw fixation showing lack of destruction of the articular facet between L4 and L5; this film was made at time of follow-up studies (over one year postoperatively).

another patient, on the third postoperative day, severe left-sided sciatic pain developed, the cause of which remained uncertain until she returned for follow-up x-ray examination. The films demonstrated that the upper left screw had fractured the superior facet of L5, resulting in some collapse of the foramen and consequent pressure on the 4th lumbar nerve root. The sciatic pain subsided after several weeks, but the patient has had several mild recurrences.

COMMENTS

It was possible to follow up only thirteen of the sixteen patients. All thirteen were submitted to examination both clinically and roentgenographically. The follow-up physical findings were then correlated with the preoperative findings. Roentgenographic examinations having been made in all cases, these films were then compared with the preoperative and immediate postoperative films.

Personal examination by two of the authors substantiated by x-rays demonstrated motion at the fusion site in all cases. In two cases there was increased motion above the attempted fusion site with percussion tenderness over the spinous processes of L2 and L3. All patients demonstrated some limitation of spinal motion in the lumbosacral area. Reflex and sensory changes of the lower extremities were unchanged from their preoperative state, regardless of laminectomy with removal of a ruptured nucleus pulposus. Eight patients complained of a persistent coccygodynia which had developed postoperatively and listed this as their chief annoyance. This may possibly be explained by decreased motion of the lumbosacral joint, with the slumped position, so often affected in sitting, placing undue stress and strain on the coccyx. Roentgenographic examination demonstrated that in thirteen cases there was no fusion of the posterior elements between L4 and L5 and there had been absorption of some of the bone grafts. (Fig. 1.) Three cases demonstrated a fusion between L5 and S1. The reaction about the screws was slight but sufficient to indicate that motion was present. The articular cartilage of the facets had not been erroded as expected, resulting in lack of fusion between these elements. (Fig. 2.) In two of the cases a facet had fractured and in both cases it was the superior facet of L5 on the left. Seven of the thirteen

patients wore a support postoperatively, and it was the concensus that the support added to their comfort during this period. In each case it was a corset of the lumbosacral type and all seven had used this support preoperatively. The use of the bed board was a matter of individual reaction. With some it proved a vital necessity, with recurrences of pain when not in use; with others it was discarded.

Other postoperative complaints of the patients varied. Four were completely asymptomatic and six had intervals of mild discomfort. These ten patients were completely satisfied with the results of the operation notwithstanding the fact that from a surgical viewpoint none had obtained a complete fusion (the object of the procedure). Three patients were dissatisfied with the results of the operation. Two were housewives who believed the operation had limited their ability to carry out their household duties and had not relieved their original pain. In the third case, that of a semi-skilled laborer dissatisfied with his work, a large functional element was involved, leaving doubt as to the true measure of the patient's evaluation. In view of the numbers of pseudarthroses it was remarkable that there were so few expressions of dissatisfaction among the patients. Five of the thirteen patients had been unable to return to their original occupation. Of these five one was the compensation case and two were the housewives mentioned previously. The remaining two were laborers, the only two heavy workers in this series.

The problem of evaluation of these cases presented a difficult one. None of the thirteen cases had obtained a satisfactory surgical end result, yet ten of the patients had been definitely benefited symptomatically by the operation. Correlated with the physical findings of limitation of spinal motion, it is our opinion that this limitation of motion accounts for the relief of symptoms.

CONCLUSIONS

Careful consideration of the follow-up studies suggested the following: (1) This operative technic should be limited to carefully selected cases. (2) If this technic is selected, we would recommend limitation of this type fusion to the lumbosacral joint, careful adherence to the operative technic and the use of sufficient iliac bone at the site of fusion. (3) There should be exclusion of this type fusion in the unstable back of the laborer if he anticipates returning to his previous occupation.

SUMMARY

This study consisted of a complete physical and radiologic examination plus evaluation both from an objective and a subjective standpoint. In our hands this operative procedure has failed to produce the satisfactory end results which had been anticipated.

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EXPERIENCES WITH THE OPERATIVE CORRECTION OF PORTAL HYPERTENSION*

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THE brilliant studies of Allen Whipple and his associates have contributed new clinical concepts and fresh surgical approaches to the problem of portal hypertension.[1–6] It is now apparent that a number of conditions loosely grouped under the general term of Banti's disease[7,8] may cause obstruction to the portal vascular bed and produce esophageal and gastric varices, ascites and occasionally devastating hemorrhages. The surgical treatment used to correct portal hypertension depends upon the location and type of the obstruction, whether extra- or intrahepatic, and the physiologic status of the patient. Those with an extrahepatic block may not be suitable candidates for the direct portacaval shunt because of the occasional absence of the portal vein. Cavernomatous transformation of the portal vein, which in some instances is most likely a collection of collateral veins about a thrombosed portal vein, also does not permit a direct portavenacaval anastomosis. Under such circumstances the most suitable procedure is a splenectomy and the establishment of a splenorenal shunt.[9] Thrombosis or occlusion of the splenic vein close to the spleen as a cause of splenomegaly and hemorrhage is treated successfully with splenectomy alone.

The intrahepatic portal block due to cirrhosis has been treated both with direct portacaval and with splenorenal shunts. The greatest care is required in the selection of patients suitable for such surgical treatment and in their preparation for operation. Gastrointestinal hemorrhages and wasting ascites deplete the blood proteins and prothrombin deficiency may further encourage bleeding. The prothrombin and serum albumin should be raised to safe levels by a proper medical regimen before these patients are subjected to operation.

Ligation of the splenic artery alone has been used to advantage in the treatment of these patients. Blain[10] recommended it in poor risk patients and this view is supported by Everson and Cole[11] and by Linton and his associates[12] who used it preliminary to a subsequent splenorenal shunt in poor risk patients. From all the evidence at hand it would appear to be advantageous to combine ligation of the splenic artery with the direct portacaval shunt, when this is the operation chosen, since the reduction in volume of portal blood flow which follows its ligation may further reduce the portal hypertension.

Occasionally one may resort to less direct methods of establishing connections between the portal and systemic venous systems. A number of years ago[13] portal hypertension in dogs was produced by a two-stage ligation of the portal vein. This was then corrected by implanting the scarified spleen in a peritoneal pocket made in the abdominal wall at the site where the spleen lay. The splenic artery was doubly ligated and divided. Subsequent injections showed that the flow through the splenic vein was reversed and that portal blood was being deflected into the systemic circulation by way of the collateral bed established between the spleen and the abdominal wall. Two successful clinical applications of this procedure are reported in this group of patients.

The purpose of this paper is to report our experiences with the treatment of portal hypertension in sixteen patients. The group has been separated into two, namely, those who had cirrhosis and those in whom the liver was normal on microscopic examination. (Tables I and II.) There were nine patients in whom the portal hypertension was due to cirrhosis of the liver. In only five of these patients was operation of any benefit and in the remaining four operative intervention clearly hastened the fatal outcome.

Ascites was a prominent symptom in the four patients who died although three of the four

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had severe gastrointestinal hemorrhages as well. On the other hand, two of the five living patients had no ascites and in three the ascites was only moderate; but in four of the five patients hemorrhage was definitely the predominating symptom. Three portacaval, one splenorenal and one ligation of the splenic artery with splenopexy and omentopexy comprise the successful group. The latter patient, upon whom operation was done for ascites, at first was made worse by the operation. After a year, however, the ascites lessened and she now has none but does complain of slight leg edema after long walks. Thus, if benefit in this patient has resulted from the splenopexy and omentopexy, it required more than a year for sufficient collateral to develop.

TABLE I

RESULTS OF OPERATIONS UPON PATIENTS WITH PORTAL HYPERTENSION AND CIRRHOSIS

Case	Age, Sex	Operation	Date of Operation	Hemorrhage		Ascites		Present Status
				Preoperatively	Postoperatively	Preoperatively	Postoperatively	
I	28 M.	End-to-side portacaval	1/17/50	Severe	None	Moderate	None	2/1/51 at work
II	37 F.	Side-to-side portacaval (Splenectomy, 1/45)	4/16/49	Severe	None	None	None	4/25/50 apparently well
III	51 F.	End-to-side portacaval	2/4/50	Severe	None	Moderate	None	2/51 no bleeding or ascites
IV	12 M.	Splenorenal	3/12/49	None—marked esophageal varices	.....	None	None	2/51 well
V	51 F.	Ligation, splenic artery Splenopexy, omentopexy	4/26/40	None	None	Moderate	Severe for 1 year	2/18/51 leg edema occasionally
VI	38 M.	Attempted portacaval, failure Splenectomy, attempted splenorenal, failure	5/11/49 6/28/49	Severe	Severe	Slight	Moderate	Died 2 mo. postoperatively
VII	46 M.	Splenorenal	6/1/49	None	.....	Severe	.....	Died 2 hr. postoperatively
VIII	23 M.	Side-to-side portacaval	5/25/49	Severe	.....	Severe	.....	Died 2 days postoperatively
IX	55 M.	End-to-side portacaval	1/5/50	Severe	None	Moderate	Severe	Died 5/27/50

The seven patients who had portal hypertension with a normal liver presented a different picture. All had moderate to severe gastrointestinal hemorrhage and none had ascites. Four had had a splenectomy with no benefit or with a period without hemorrhage which lasted from several months to several years. There has been no fatality in this group of patients and all of them have been without gastrointestinal hemorrhages for from five months to three and a half years. There were two portacaval and two splenorenal shunts. Curiously, one boy with cavernomatous transformation of his portal vein and a previous splenectomy had only an omentopexy performed and he has had no hemorrhages for one year. An excellent result with a three and a half year follow-up was attained in one patient with ligation of the splenic artery and splenopexy, and an equally satisfactory outcome followed division of duodenal, gastric and esophageal veins, combined with omentopexy, in a patient who had had no relief from hemorrhages by splenectomy. It is apparent, therefore, that excellent results can be attained by a number of means in pa-

tients with portal hypertension in the presence of a normal liver.

Certain technical considerations may be of interest. An intriguing and invariable observation at each operation upon the cirrhotic patient was the presence of numerous, conspicuously prominent and greatly distended lymphatic vessels coursing along and paralleling the portal vein, apparently transporting lymph from the liver toward the retroperitoneal lymph nodes and thence into the thoracic duct. This phenomenon is probably related to certain peculiarities of the deep lymph flow from the liver which has its origin in a rich plexus of lymphatic spaces and vessels surrounding each portal vein capillary, the extent of such lymph flow being directly proportional to portal venous pressure. The increased pressure in these conspicuous lymphatic vessels is probably related also to the development of ascites.

The most direct approach for the exposure of the portal vein and vena cava for the execution of the portavenacaval anastomosis has been found to be the subcostal incision paralleling the mid-costal margin, with incision of the linea alba for 4 to 5 cm. to the xiphisternum and the division of the costal cartilage opposite the fifth interspace.[14] This incision permits lateral displacement of the lower rib cage and following division of the round ligament a lateral rotation of the liver will bring into direct view the structures concerned in the anastomosis. (Fig. 1.)

TABLE II

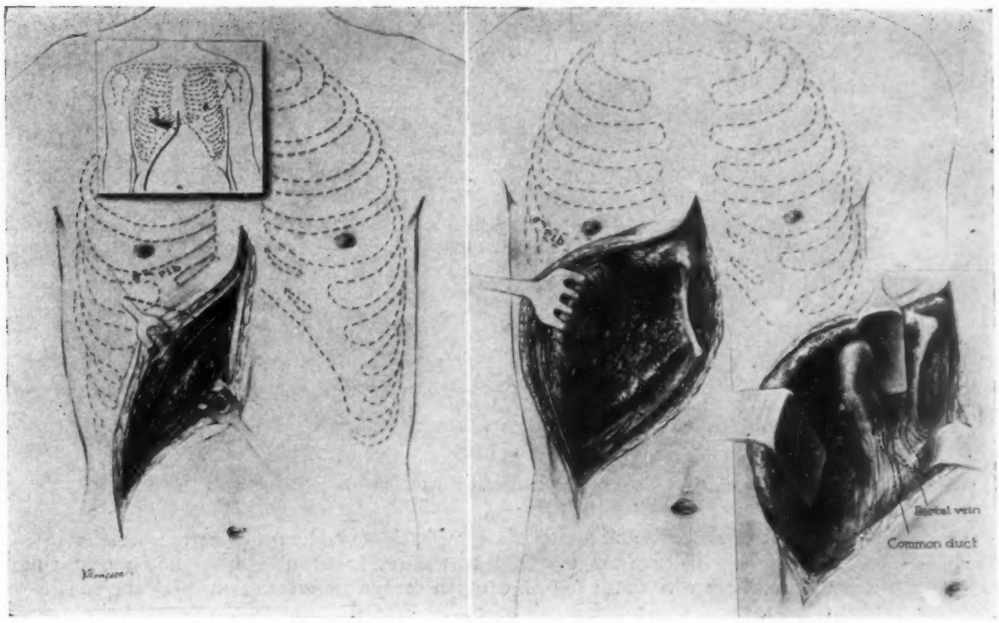
RESULTS OF OPERATIONS UPON PATIENTS WITH PORTAL HYPERTENSION AND NORMAL LIVER

Case	Age Sex	Normal Liver Operation	Date of Operation	Hemorrhage		Ascites		Present Status
				Preoperatively	Postoperatively	Preoperatively	Postoperatively	
R. F. P.	26 F.	Ligation, esophageal and gastric veins; ligation, splenic artery; splenopexy	6/15/43 7/15/47	Severe Severe	Severe None	None None	None None	Well, 12/18/50
H. L.	19 M.	Splenectomy; end-to-side portacaval	3/11/50 5/4/50	Severe Severe	Severe None	None None	None None	Well, 2/51
J. E.	5 M.	Duodenal vein-caval; ligation, splenic artery	3/8/49	Severe	8 mo. later, severe	None	None	Well, 2/51
		Splenorenal	3/2/50	Severe	None	None	None	
R. P.	6 M.	Splenectomy	*1946	Moderate	Well 3 yr., then moderate	None	None	Well, 7/10/50
		Omentopexy	7/29/49	Moderate	None	None	None	
M. K.	30 F.	Splenectomy; division, esophageal, gastric and duodenal veins, omentopexy	1930 12/12/46	Moderate Moderate	Moderate None	None None	None None	2/7/51 dizzy spells, working full day
T. M.	23 M.	Splenectomy	1945	Severe	Well 1 yr., then severe	None	None	Well, 11/24/50
		End-to-side portacaval	7/5/50	Severe	None	None	None	
J. B.	27 M.	Splenorenal	7/23/49	Severe	None	None	None	Well, 6/29/50

The following case reports are presented to illustrate portal hypertension with cirrhosis of the liver. (Table I.)

CASE REPORTS

CASE I. R. S., aged twenty-eight, entered Fort Ord Hospital November 29, 1949, complaining of massive vomiting of blood and tarry stools. The past history revealed that the patient had malaria during the second World War. He denied drinking to excess but admitted drinking two or three beers every night. He was treated for shock with whole blood and intravenous fluids. On December 2, 1949, he had another hemorrhage. On December 5, 1949, a laparotomy was performed because of severe epigastric pain. An ulcer was not found but

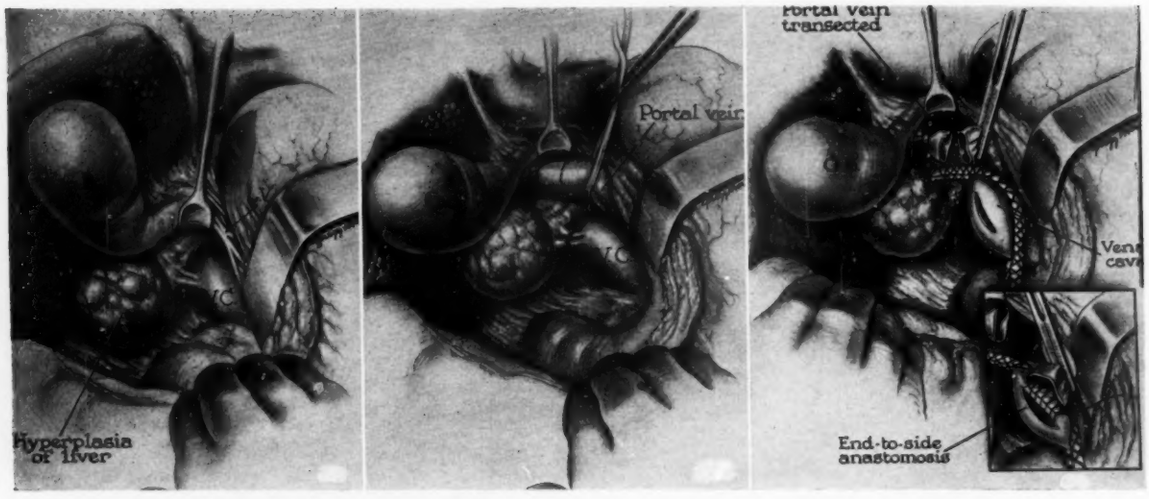


1A 1B

FIG. 1. Incision of choice for exposure of portal vein and vena cava parallels the mid-costal margin with vertical extensions at both ends and excision of costal cartilage opposite 5th interspace.

enlarged venous channels were noted in the round ligament. There was a large amount of ascitic fluid and the liver was enlarged. The spleen was congested and mottled. The procedure was terminated because of his poor condition. Postoperatively, progressive abdominal distention developed and a paracentesis was necessary on December 9, 1949. Studies revealed a high thymol turbidity and a low protein, with a decreased albumin-globulin ratio. On December 13, 1949, he was transferred to the Letterman General Hospital where physical examination revealed an icteric tinge to the scleras and a protuberant abdomen, an enlarged spleen and a healing laparotomy scar. The prothrombin time was markedly lowered and the Vandenberg elevated. Roentgenograms demonstrated large esophageal varices. The patient had two large tarry stools on December 21st followed with shock. This was repeated on January 6th and on January 7, 1950. During these hemorrhages it was necessary to give a number of transfusions which were supplemented with vitamin K. On January 17, 1950, abdominal exploration revealed a small, cirrhotic liver, a large amount of ascitic fluid and an enlarged spleen. An end-to-side portacaval anastomosis was performed. During the immediate postoperative period his jaundice increased perceptibly but gradually faded. On February 20, 1950, edema of both legs developed which responded to bed rest and elevation. Ascites was still present. He was dismissed from the hospital on temporary leave and after being away for two weeks returned complaining of acute pain in the right lower quadrant and a fever of 103°F. A diagnosis of appendicitis was made and an acutely inflamed appendix was removed. He recovered from this operation uneventfully and was dismissed from the hospital. He was last seen on February 1, 1951, at which time he was on full duty as a guard. His only complaint is edema of the legs which develops after long walks. He has had no further ascites or gastrointestinal bleeding and roentgenograms revealed a marked decrease in size of the esophageal varices. (Fig. 2.)

CASE II. M. McF., aged thirty-seven, entered Lane Hospital on April 10, 1949, complaining of repeated hematemesis. She had been well until six years previously when she became nauseated and vomited much dark brown material followed with bright red blood, and concurrently, she had tarry stools. Since 1943, she had had nine such episodes, requiring altogether fifty transfusions. There was no history of jaundice, alcoholism or of any toxic agent. A splenectomy was performed in January, 1946, and the three hemorrhages which followed this had not been as severe.



2A 2B 2C

FIG. 2. Case I. In the presence of cirrhosis and ascites the lymphatics (LV A) paralleling the portal vein are invariably greatly dilated transporting lymph from the liver to the retroperitoneal nodes and receptaculum chyli. Note large lobe of regenerated liver with nature's own compensatory communications with the vena cava. B and C, technic of end-to-side portacaval anastomosis using Pott's serrated clamp on the portal vein and half circle bronchus clamp, each blade wrapped with silk, on the vena cava.

Physical examination revealed a pale, asthenic woman. The abdomen showed the 10 cm. scar in the left upper quadrant; no organs or masses were felt. Although roentgenograms did not definitely reveal varices, they were seen on esophagoscopy. Laboratory studies and liver function tests were essentially normal. Operation was performed on April 16, 1949. Distended and tortuous veins on the stomach and esophagus were found and portal vein pressure was recorded at 19 cm. of water. The liver was small and appeared fibrotic; a biopsy was taken. A side-to-side portacaval shunt was performed. She had an uneventful recovery and in April, 1950, she was reported by her physician as being very well and as having no hemorrhages. She was being treated for mild hyperthyroidism.

CASE III. M. C., aged fifty-one, entered the hospital complaining of repeated hematemesis. At the age of twelve the patient had had malaria and at fifteen another attack of malaria. During this time she had her first episode of right upper quadrant pain and mild jaundice. The intermittent episodes of right upper quadrant pain continued until 1935 when she had an acute attack with rather severe jaundice. She was placed on a high protein diet. In 1940 her first attack of hemoptysis occurred while carrying a heavy pile of linen upstairs. The right upper quadrant discomfort continued until May, 1949, when the patient had a massive hematemesis. She was hospitalized and given a transfusion. The next hematemesis occurred one month later but was smaller in quantity. She then felt fairly well for about six months when another massive hematemesis occurred. On January 14, 1950, after receiving one transfusion, her hemoglobin was 33 gm. per cent. During the two weeks prior to her entry to the hospital the patient noticed a gradual enlargement of the abdomen and a constant tenderness along the costal margin. She also felt there was some jaundice. She stated that she had had hemorrhoids for twenty-five to thirty years. Recently, they had become more pronounced and had been bleeding. There had been no exposure to toxic drugs but the patient stated that she had taken alcohol daily in moderate quantities during the past twenty years. On physical examination she was a well developed middle-aged woman without any discomfort. The skin showed a slight icterus and a few spider angiomas were noted on her face and neck. The abdomen was distended and tense with tenderness across the costal margin and bilaterally. The spleen was not palpable. There were numerous dilated veins over the abdomen and umbilicus. The liver was palpable and tender. There was obvious fluid in the peritoneal cavity. Laboratory studies revealed a prothrombin time of 30 per cent of normal. Platelet count was 83,000, icterus index 36 units and non-protein

nitrogen 35 mg. per cent. The hematocrit was 30 and the erythrocytes 3.2 million. The hemoglobin was 9.6 gm. per cent. White blood cells numbered 8,600, with 58 per cent polymorphonuclears and 34 per cent lymphocytes. The cephalin flocculation test was 4 plus and roentgenograms revealed marked esophageal varices in the lower third of the esophagus.

After suitable preparation with transfusions, high protein diet and vitamins, the abdomen was explored through an S-shaped, right, subcostal incision on February 4, 1950. There was considerable free, straw-colored fluid. The liver was markedly enlarged, purplish white in color, and had a gross appearance of cirrhosis. It was necessary to aspirate the gallbladder in order to gain a proper exposure of the portal vein region. There were many tortuous dilated veins in the transverse mesocolon and overlying duodenum. Pressure in one of these was found to be 29 cm. of water. The portal vein was dissected free with difficulty because of its abnormal position posterior and medial to the hepatic artery. The vena cava was dissected free and branches to both left and right renal veins were exposed. A mid-hepatic lobe of the liver protruded out toward the region of the proposed anastomosis interfering somewhat with the accessibility to the inferior vena cava. It was decided that an end-to-side portacaval shunt was feasible and this was done without undue difficulty. The venous pressure taken after the shunt was open was found to be 23 cm. of water. The patient received 3 units of blood during the operation. On February 8th it was necessary to remove 1,:00 cc. of clear fluid from the thorax. On February 10th 1,400 cc. were removed from the right thorax, 1,800 cc. on February 14th, 1,700 cc. on February 15th and 1,650 cc. on February 17th. On February 11th the icterus index was found to be 25 units. She was dismissed from the hospital on February 17th. On February 27th the icterus index was 15 units. (Fig. 3.)

FIG. 3. Case III, M. C., apparent complete recovery from hemorrhages and ascites in a fifty-one year old woman following portacaval anastomosis through an extended subcostal incision.

On January 15, 1951, this patient was reported by her physician as being perfectly well. She had been on a hunting trip in the preceding month and had taken a long motor trip without trouble.

CASE IV. J. O., aged twelve, was brought to the hospital for treatment of bleeding esophageal varices. He had been well until May, 1943, when a febrile illness developed with general malaise and upper abdominal pain. One physician diagnosed appendicitis but no operation was performed and another physician diagnosed malaria and gave the patient quinine. A third physician made the diagnosis of gallbladder disease and explored the patient. It is not quite clear what was found at operation but the gallbladder was drained. He was hospitalized for six weeks during which time he had bouts of chills and fever. He was then well until the early part of December, 1948, when he again complained of general malaise following which his urine became dark, his stools became light and he became slightly jaundiced. His liver and spleen were enlarged and there was a questionable ascites. Although no hemorrhage occurred, on two occasions his hemoglobin was found to be 39 gm. per cent and 58 gm. per cent. Roentgenograms revealed extensive esophageal varices. Physical examination on this entry revealed a slightly thin boy who was mildly icteric. There were no spider angiomas. There was a 9 cm. right upper quadrant scar. The abdomen was protuberant, more so in the upper quadrants, and the spleen was palpated several fingerbreadths below the left costal margin. The liver could not be felt. There were a few moderately distended superficial veins in the upper abdomen. Laboratory studies revealed a bromsulphalein retention of 90 per cent at 45 minutes. The platelets were 133,000 per cu. mm. Bleeding time was 3¼ minutes and the coagulation time 2½ minutes. The direct Vandenberg was 3.4 mg. per cent and the

indirect 1.85 mg. per cent. The urine showed a 2 plus bilirubin. The urobilinogen was present at 1:80 dilution. There was some bile in the stool. The prothrombin time was 100 per cent of normal. The cephalin flocculation test was negative. On March 12, 1949, the abdomen was explored through a left thoraco-abdominal incision. Many dilated and engorged veins were noticed throughout the portal bed. Pressure in one of these veins was 35 cm. of saline solution. The liver was small, nodular, dark green and very firm. A biopsy was taken. It was not possible to expose the portal vein region adequately because of adhesions. A splenectomy and splenorenal shunt was then performed with an end-to-side anastomosis between the splenic and renal veins. Following the opening of the shunt the portal pressure was taken in a gastric vein and found to be 26 cm. of saline solution. When the shunt was closed, the pressure rose again to 55 cm. His postoperative course was essentially uneventful except for a rather persistent fever. His platelets rose to 513,000 and his bromsulphalein retention on the sixth postoperative day was 50 per cent in 45 minutes. His jaundice gradually cleared and after a few months he returned to school. He has had no symptoms since the operation and his last examination in February, 1951, was essentially negative.

Case v. E. M., aged fifty-one, entered the hospital on April 22, 1940, complaining of dyspnea, ankle edema and fluid in her abodmen of four months' duration. Her past history included malaria and pneumonia as a child. She had typhoid fever when she was fourteen. About three or four years previously there had been a gradual onset of dyspnea and palpitation on exertion; this was associated with some ankle edema. About four months before entry her abdomen began to swell painlessly. This followed a period of considerable precordial, left-sided pain, which was never satisfactorily explained. Since the onset the patient has required paracentesis on two occasions, each time 7 L. of fluid being removed. Physical examination revealed a very thin and ill-appearing woman who was almost cachectic. The abdomen was markedly protuberant and obviously filled with fluid. Examination of the heart was negative. Laboratory studies showed a red cell count of 5.3 million, white cell count of 7,400 with a normal distribution and a hemoglobin of 86 gm. per cent. Curiously, the Wassermann reaction was negative during the presence of the ascites but subsequently it became positive. On April 26, 1940, the abdomen was explored through a left subcostal incision. A large amount of clear fluid was present in the abdominal cavity. The spleen was almost five times normal size and projected well below the costal margin. The liver was small and very nodular. A pathologist was called and in his opinion this was a nodular syphilitic liver. A biopsy was taken which, however, showed what was considered to be typical cirrhosis. The splenic artery was ligated in continuity with three interrupted sutures. The spleen was then implanted in a pocket in the parietal peritoneum which had been freed from the lateral abdominal wall. A second pocket was made near the epigastrium and the scarified omentum was placed in this region. The spleen was scarified by small incisions before it was implanted into this pocket. The abdomen was then closed including some of the omentum in the closure of the posterior sheath. It was necessary to remove 3,000 cc. on the fifth postoperative day. During the following year the patient stated that she felt much stronger, but during this time it was necessary to continue the paracenteses every six days.

On February 18, 1951, she reported that she no longer had ascites but had occasional edema.

Case vi. J. S., aged thirty-eight, a chronic alcoholic, entered the hospital on May 6, 1949, complaining of intermittent hematemesis for one year. He had been a heavy drinker for thirteen years, consuming a quart of wine daily. He stopped drinking about a year and a half before entry. The onset of hematemesis a year ago had been sudden and came while he was doing some heavy lifting. At this time he had a swollen abdomen and shortly thereafter red spots developed on his neck and trunk. Since this first episode he had had six moderately severe hemorrhages, associated with straining or lifting, and requiring hospitalization and transfusions. Physical examination revealed many spider angiomas of the neck and thorax. The abdomen was distended, the liver edge was firm and descended four fingerbreadths below the costal margin. The spleen was enlarged. There was slight pitting edema of the ankles. The red cells numbered 3.6 million, the white cells 5,200 and he had a hemoglobin of 10.2 gm. per cent. The prothrombin time was normal. The bromsulphalein test showed

12 per cent retention in 45 minutes. The bleeding time was 14 seconds. The cephalin flocculation test was negative, serum proteins were 6.5 gm. per cent and the albumin/globulin ratio was 3.82/2.62. The Wassermann reaction was negative. Roentgenograms showed no evidence of esophageal varices but gastric varices and a deformity of the duodenal bulb were seen. A diagnosis of cirrhosis of the liver with portal hypertension was made. At operation on May 11, 1949, a greatly enlarged nodular cirrhotic liver was found; there was some free fluid and some enlarged veins were present along the stomach and lower esophagus. A pressure reading in one was 35 cm. of water. Due to the large size of the liver it was impossible to approximate the portal vein to the inferior vena cava, so this procedure was abandoned, with the prospect of performing a splenorenal shunt later. He required thoracentesis and paracentesis postoperatively. On June 28, 1949, through a left thoraco-abdominal incision, an enlarged spleen was removed and a splenorenal shunt was attempted, but the splenic vein was too short to reach the renal vein thus precluding an anastomosis.

He recovered from the operation and was dismissed from the hospital on July 7, 1949. Shortly thereafter his condition became worse and he expired in his home on August 25, 1949.

Case VII. R. C., aged forty-six, entered the hospital complaining of cirrhosis of the liver. Ten years ago before entry he began having intermittent attacks of chills and fever which were associated with slight jaundice. Three years before entry he had a cholecystectomy for a solitary gallstone; cirrhosis of the liver was noted at operation. His physician gave him salyrgan thereafter to prevent fluid from accumulating in his abdomen. He felt reasonably well during the following year and a half, but he still had occasional fever. In November, 1948, edema of his legs and swelling in his abdomen became rather marked and he required paracentesis of 2 to 3 gallons of fluid every two to three weeks. Examination on this entry, May 13, 1950, revealed an emaciated man who was slightly jaundiced. There were spider angiomas on his face and thorax and the scleras were icteric. The abdomen showed a scar in the right upper quadrant, an enlarged nodular liver and a barely palpable spleen. A definite fluid wave was present. Laboratory studies revealed an icterus index of 30 units, prothrombin time was 67 per cent of normal, the plasma proteins were 6.02 gm., the albumin 3.07 per cent and globulin 2.95 per cent. The bromsulphalein showed 64 per cent retention in 45 minutes and the cephalin flocculation test was 3 plus. He was observed on the medical ward for two weeks during which time he had a fever and required paracentesis. On June 1, 1949, abdominal exploration showed much ascitic fluid, a small cirrhotic liver and numerous adhesions which had resulted from his previous operation. A splenorenal shunt was attempted but due to the friability of the renal vein a satisfactory anastomosis was not possible. In the end the renal vessels had to be ligated. At the conclusion of the procedure the patient's condition was critical, and in spite of supportive measures he expired several hours later.

Case VIII. R. R., aged twenty-three, entered the U. S. Veterans Hospital, Fort Miley, on March 15, 1949, complaining of repeated gastrointestinal bleeding. There was no history of jaundice, toxic agents, alcoholism or other factors which might have caused hepatic disease.

In April, 1947, diarrhea developed, with loss of weight and pain in the right upper quadrant. He was hospitalized and upon examination it was found that he had an enlarged liver and spleen and spider angiomas over the upper body and dorsum of the left hand. A diagnosis of chronic hepatitis without jaundice was made. In July, 1947, laboratory studies showed a bromsulphalein retention of 20 per cent and a cephalin flocculation of 2 plus. Subsequently, a liver biopsy showed fibrosis and some round cell infiltration compatible with hepatitis. He was treated appropriately, with some clinical improvement, except that during a course of methyltestosterone jaundice developed. In the following six months he had two major episodes of gastrointestinal hemorrhage and following one of these esophageal varices were demonstrated by roentgenography and esophagoscopy. It was considered advisable to attempt a portacaval anastomosis to reduce his portal hypertension. Laboratory studies on this entry revealed a hemoglobin of 11.5 gm. per cent, red cells, 3.48 million, white cells, 11,950, bleeding time of 2 minutes, coagulation time of 4 minutes, negative Wassermann, 25 per cent retention of bromsulphalein, a 4 plus cephalin flocculation, icterus index of 14.4, prothrombin

time 52 per cent of normal, thymol turbidity of 12.2, total proteins 6.17, albumin 3.78 per cent, globulin 2.41 per cent and platelets 112,000. On May 25, 1949, the abdomen was explored through a right thoraco-abdominal incision. The liver was small, fibrotic and nodular; there were numerous dilated veins and the pressure in one was found to be 39.6 cm. of water. A side-to-side portacaval anastomosis was accomplished following which the venous pressure fell to 30 cm. of water. A liver biopsy was taken. His postoperative course during the first day was essentially normal but on the second day he showed evidence of retention of fluid and later in the day pulmonary edema developed which caused his death that evening.

CASE IX. M. McE., aged fifty-five, had spent the last twenty-five years drinking a quart of whisky a day. He had had jaundice at the age of sixteen. Cirrhosis of the liver and marked gastric and esophageal varices were easily demonstrated. During the three months preceding his admission, he had had three major hemorrhages, the last one in December, 1949. He had been given a total of ten to twelve transfusions at that time and on previous occasions multiple transfusions had been necessary. On this occasion, while waiting for operation, he had a sudden hemorrhage and vomited about 1,000 cc. of black and bloody gastric contents. On examination he was pale, middle-aged and looked ill. There were obvious spider angiomas over the neck and arms. Examination of the heart revealed a systolic murmur over the precordium. An enlarged, hard liver was demonstrable with a nob protruding in the midline which might have been the gallbladder. The spleen was not palpable and there was some fluid demonstrable. He had obvious hemorrhoids. Blood studies revealed a hematocrit of 29, hemoglobin of 9.3 gm. per cent, 7,250 white cells with a normal distribution. After suitable preparation with transfusions and a high protein diet with accessory vitamins, operation was performed on January 5, 1950, through a right subcostal incision which was extended through the costal cartilages opposite the fifth interspace. The liver was found to be enlarged, hard and hob-nailed in appearance. There was considerable free fluid, ascitic in nature, in the abdomen. There were numerous distended veins throughout the portal bed and a measurement of the portal tension was found to be 45.8 cm. of water. Due to a large and distended gallbladder, it was necessary to do a cholecystectomy so that the portal vein could be exposed. The portal vein was freed over a distance of about 6 cm., the vena cava was identified and an end-to-side portacaval shunt was performed. Following the establishment of the shunt the portal pressure was found to be 23.5 cm. A biopsy of the liver was taken and it subsequently showed well advanced cirrhosis. He was dismissed from the hospital on January 17, 1950, after an uncomplicated postoperative recovery. Soon thereafter he again required paracentesis every week and several months later symptoms of pyloric obstruction due to a duodenal ulcer developed. Cholemia and pyloric obstruction caused his death on May 27, 1950. Necropsy revealed advanced cirrhosis, ascites and a perforating and obstructing duodenal ulcer. The portacaval shunt was patent.

PORTAL HYPERTENSION WITH NORMAL LIVER

The following patients (Table II) had portal hypertension with a normal liver: R. F. P., aged twenty-six, entered the hospital complaining of vomiting blood. At the age of nine she had had a sore throat which was followed with mastoiditis, complicated by a metastatic suppuration in the left hip and subsequently osteomyelitis of the ilium. In 1941 she was in an automobile accident and suffered a fractured vertebra. In February, 1943, she thought she had influenza. This was associated with some vomiting and she noticed a fairly large amount of blood mixed with the vomitus. On another occasion in April, 1943, while sitting in a movie, she suddenly felt nauseated and vomited a considerable amount of fresh blood. Roentgenograms were subsequently taken revealing extensive esophageal varices and no evidence of gastrointestinal ulceration. Physical examination on entry revealed a well developed and nourished girl. There were no positive physical findings referable to the liver or the portal bed, with the single exception of a palpable spleen. On June 15, 1943, a thoracotomy was performed and a number of dilated and tortuous veins in the lower end of the esophagus, upper end of the stomach and diaphragm were ligated and transected. A biopsy of the liver was normal. Three weeks after the operation the patient had another severe hematemesis and her hemoglobin dropped to 15 gm. per cent. Between 1943 and 1947 she had two other severe attacks of bleeding. Due to this the patient was again hospitalized and

the esophageal varices were again noted on roentgenography. Laboratory studies revealed a serum protein of 6.2 gm. per cent, a normal prothrombin time, and normal bleeding and coagulation times. Due to the repeated hemorrhages an operation was performed on July 15, 1947, through a left subcostal incision. A large, dark, firm spleen was found. The liver appeared to be normal. There was definite distention of the veins in the gastrointestinal tract and the venous pressure, as measured in a vein on the lesser curvature of the stomach, was 25 cm. of water. The splenic artery was doubly ligated and transected and an incision was then made in the lateral peritoneal wall where a pocket large enough to admit the spleen was developed by freeing the parietal peritoneum. The capsule of the spleen was then removed over its lateral surface and the spleen was implanted in the peritoneal pocket. The surface of the liver was scarified and powdered with talcum powder and the omentum was incorporated in the suture of the peritoneum and posterior sheath. Her postoperative course following this operation was uneventful. She was last seen on December 18, 1950, at which time she stated that she had had no further bleeding since the operation, no weakness and that she had been able to maintain a full schedule of work every day.

H. L., aged nineteen, was a Chinese-American who had been born in Hongkong and had lived there throughout his childhood. There was no history of dietary deficiency, jaundice or tropical disease. He drank in moderation. On February 13, 1950, while on guard duty in Okinawa, he was suddenly stricken with a massive hematemesis and subsequently had tarry stools. During the following month he had five more hemorrhages, the average loss of blood each time being 1,600 cc. Roentgenograms showed esophageal varices. On March 11, 1950, as an emergency measure, a splenectomy was done. At this time studies showed 2.7 million red blood cells, a hemoglobin of 7.5 gm. per cent, 1,950 white cells and 27,000 platelets. After evacuation to San Francisco on April 9, 1950, he had a massive hemorrhage of about 1,700 cc. and on April 16th another of 2,900 cc., each requiring multiple transfusions. Laboratory studies showed that the total proteins were 8.1, the albumin 4.1, globulin 4.0, Wassermann reaction negative, bromsulphalein showed 10 per cent retention in one hour. The zinc sulfate turbidity was 15 units and the cephalin flocculation was negative. There was no evidence of parasites in the stools.

On May 4, 1950, an end-to-side portacaval shunt was done. The liver was grossly normal and this was confirmed by subsequent microscopic study of a biopsy. The venous pressure in a portal vein was 36 cm. of water. There was no ascites. He had a smooth postoperative course and three weeks after the operation laboratory studies showed 3.48 million red cells, a hemoglobin of 11.2 gm. per cent, bromsulphalein 35 per cent retention at 45 minutes, the prothrombin time was 42 per cent of normal, the total protein was 6.5 gm., with 3.7 gm. albumin and 2.8 gm. globulin. The thymol turbidity was 4 units, cephalin flocculation 2 plus and the zinc sulfate turbidity 20 units.

He was last seen in February, 1951, when he was in good health and no further bleeding had occurred.

J. E., aged five, was brought to the hospital by his mother complaining of vomiting of blood. He had been perfectly well until June, 1948, when one night he called his parents who found that he had vomited a large quantity of blood. The following night he again vomited two or three times and the next day his red cells numbered 1.9 million. He was subsequently taken to a hospital where roentgenograms revealed esophageal varices and an enlarged spleen. After proper treatment for the secondary anemia, he regained his health and remained well for six months. In January, 1949, he had tarry stools for five days, became pale and had a few abdominal cramps. His red cells numbered 2.5 million at that time. In February, 1949, he awoke with severe abdominal pain one night and again vomited about 1 pint of blood. Two weeks later he again vomited blood on three occasions and was taken to the hospital. After repeated transfusions and vitamin K, the bleeding stopped. On physical examination he was extremely pale and tired. There was a systolic murmur along the left sternal border and at the apex of the heart. The abdomen was slightly distended and a smooth liver edge was felt 3 cm. below the left costal margin. Rectal examination revealed hemorrhoids and roentgenograms revealed extensive esophageal varices; a diagnosis of portal obstruction was made. Laboratory studies at this time revealed a red cell count of 2.08 million, a hemoglobin of 5 gm. per cent and a white cell count of 28,600. The prothrombin time was normal, the proteins were 5.65 gm. per cent, the albumin 3.48

per cent and the globulin 2.17 per cent. The cephalin flocculation test was 4 plus and the platelets were 190,000. On March 8, 1949, the right side of the abdomen and thorax was opened through a combined thoraco-abdominal incision made through the eighth interspace. The liver was found to be enlarged but was otherwise normal. The gallbladder was somewhat edematous. There were several large veins in the region of the portal vein but no definite portal vein was demonstrable. A cystic vein measuring about 4 mm. in diameter was identified and the pressure in it was found to be 40 cm. of water. The only suitable vein available for an anastomosis was a collateral one measuring about 5 mm. in diameter. This was developed and anastomosed to the inferior vena cava in an end-to-side manner. Following the completion of this anastomosis the venous pressure was 40 cm. of water. The splenic artery was identified and doubly ligated with medium silk. This again did not alter the pressure in the portal venous system. The wound was then closed in layers. His postoperative course was uneventful and he was dismissed from the hospital on March 20, 1949. He remained well until November 18, 1949, when following a cold he again began vomiting large quantities of bright, red blood and on February 17th another severe hemorrhage occurred. On examination he was well developed and nourished but very pale. The liver was still palpable and the scar from the previous operation was well healed. The spleen was questionably palpable. After suitable preparation on March 2, 1950, he was again operated upon through a left thoraco-abdominal incision. A slightly large spleen was found. There were a number of collateral arterial channels carrying some blood to the spleen. The spleen was removed with the preservation of the splenic vein. A pressure of 46 cm. of water had been determined in the vein. It was possible to perform an end-to-side splenorenal shunt. During the immediate postoperative period several attacks of hematemesis occurred which again required whole blood transfusions totaling 3,500 cc. He was finally dismissed from the hospital on March 19, 1950. A note from his physician in February, 1951, stated that he has had no further bleeding, is attending school and is apparently in good health.

R. P., aged six, entered the hospital complaining of repeated attacks of hematemesis. When 5 years old he was treated at the Royal Hantz Hospital, England, for a septic foot. At that time it was noted that he had an enlarged spleen and liver and a suggestion of coeliac disease was made due to the character of the feces. At the age of two years and eight months he had had his first attack of hematemesis. Six months later a splenectomy was performed in an effort to control these attacks. The histology of the spleen showed a thick capsule, a congested pulp and dilated sinusoids and some fibrosis, the arterioles were thickened and the malpighian bodies were striking. He remained well for nearly three years following the splenectomy when he again began vomiting blood. During this period numerous blood studies were made all of which were essentially negative; these included thymol turbidity, thymol flocculation, cephalin flocculation and coagulation times and routine blood counts. On June 25, 1949, he was readmitted to St. Bartholomew's Hospital where it was noted that his skin had a slightly coppery tint. The liver was enlarged but was not tender. Laboratory studies revealed a hemoglobin of 72 gm. per cent, 4.2 million red cells, 6,500 white cells and 332,000 platelets per cu. mm. The Wassermann and Kahn reactions were negative. Serum protein studies revealed a total protein of 6.25 per cent, albumin of 4.8 per cent and globulin of 1.45 per cent. The Takata-Ara test was negative, thymol turbidity was .5 units and a normal bleeding, clotting and prothrombin time were noted. On July 29, 1949, the abdomen was opened through a right subcostal incision. The duodenum was reflected upward and the portal vein was explored. It was found to be replaced by a fibrous cord surrounded by a leash of small, tortuous veins. None of these was suitable for anastomosis with the inferior vena cava. The gallbladder, liver and biliary passages all appeared normal. The venous pressure as measured in one of the gastric veins was found to be 18 cm. of water. It was noted that a number of omental adhesions contained many veins which apparently entered the abdominal wall. All of the free omentum was gathered in the closure of the abdominal wall to encourage further the development of collateral blood supply. Histologic study of the liver biopsy showed a normal hepatic architecture, a slight increase in fibrous tissue and cellular content of the portal tracts. The boy had an uneventful postopera-

tive course and was last seen on July 10, 1950, at which time he had returned to school and no further hematemesis had occurred.

M. K., aged thirty, entered Lane Hospital on December 10 ,1946, complaining of hematemesis and melena for the preceding twenty-five years. At the age of five she fell and severely bruised her left upper abdomen. A few months later she had her first attack of hematemesis and tarry stools. During the following nine years she had an average of three severe hemorrhages per year. In June, 1930, at the age of fourteen she entered Lane Hospital where a diagnosis of Banti's syndrome was made. At this time a splenectomy was performed. One year later hematemesis and melena recurred. Esophageal varices were first noted roentgenologically in 1934. On December 12, 1946, exploration revealed numerous vascular omental adhesions to the abdominal wall which were judged to be carrying a large part of the venous collateral from the portal bed. A number of dilated veins near the esophagus and along the cardia of the stomach were divided and cauterized. The portal venous pressure as measured in an enlarged duodenal vein was found to be 38.5 cm. of water. This vein was sacrificed. The liver was small and grey and mottled in some areas. A biopsy was taken. The remaining omentum was included in the abdominal wound closure to encourage the further development of collateral. Her postoperative recovery from this operation was uneventful. Examination of the liver biopsy revealed some pigmentation around the central veins but no fibrosis. She was last seen in February, 1951, at which time she reported that no further bleeding had occurred. Her only complaint was dizziness which, however, was not enough to interfere with working a full day.

T. M., aged twenty-three, entered Stanford Hospital on June 22, 1950, complaining of tarry stools for three days. Five years previously without antecedent illness he suddenly vomited large quantities of blood and became unconscious. He was hospitalized for two months after which a splenectomy was performed. He remained well for approximately one year, then gastrointestinal bleeding recurred with attacks every three to four months. The only unusual physical finding on entry was paleness of the conjunctivas and nail beds, a loud, systolic precordial murmur and a well healed abdominal scar. Laboratory examinations showed a hematocrit of 24.5, a normal bromsulphalein excretion, normal prothrombin time, a one plus cephalin flocculation and roentgenograms showed enormous esophageal varices. After a suitable preoperative preparation operation was performed on July 5, 1950. Measurements of the portal venous pressure in a dilated gastric vein revealed a pressure of 26 cm. of water. When the portal vein was temporarily occluded, the pressure rose to 36 cm. of water. It was possible to perform an end-to-side portacaval shunt. A biopsy was taken from a normal-appearing liver. His postoperative course was essentially uneventful and three months later esophageal roentgenograms showed a diminution in the size of the varices. He was last seen on November 24, 1950, at which time there was no recurrence of his symptoms.

J. B., aged twenty-seven, entered the hospital on June 23, 1949, complaining of repeated hematemesis for four years. There was nothing in his past history to account for this bleeding and he had never taken liquor in excess. He had been able to work hard between attacks at his job as a cabinet maker. His only symptoms were those associated with gross anemia following each hemorrhage. Repeated transfusions had been necessary and on one occasion 12 pints of blood were required to restore his blood count to normal. On examination he was a healthy-appearing man in obviously excellent physical condition. The spleen was palpable three fingerbreadths below the left costal border. The liver was felt two fingerbreadths along the right costal margin and the surface was smooth; no hemorrhoids were evident. A barium swallow showed large esophageal varices and the stomach and duodenum were seen to be normal. Laboratory studies revealed a hemoglobin of 90 gm. per cent, red cell count of 5 million, while cell count of 2,500 per cu. mm. with a normal differential. The platelets were 95,000 per cu. mm.; the bleeding time and coagulation times were normal. A thymol turbidity was 2 units, the Takata-Ara was negative, the serum proteins were normal, with a normal albumin-globulin ratio. The prothrombin time was 70 per cent of normal. At operation on the twenty-third of July, 1949, a left thoraco-abdominal incision was made through the ninth intercostal space. On opening the abdomen many distended veins were encountered. The venous pressure taken in one of the gastric

veins was found to be 21 cm. of water. The pressure in the splenic vein was 23 cm. of water. The spleen was enormously enlarged and tense. The liver appeared normal. Without undue difficulty the spleen was removed with temporary occlusion of the splenic vein; it was subsequently dissected from the upper margin of the pancreas. The left kidney was then freed and the main vessels controlled with suitable instruments. An end-to-side anastomosis of the splenic vein to the renal vein was performed. Following completion of the shunt the venous pressure in the gastric vein was 19 cm. of water. The patient had an uneventful postoperative recovery and was last seen on June 29, 1950, at which time he looked extremely well and was entirely free from symptoms. There had been no further bleeding.

SUMMARY

1. The results of treatment in sixteen patients with symptoms of portal hypertension are presented.

2. In nine patients the liver was cirrhotic and the patients presented themselves for treatment because of gastrointestinal hemorrhage and ascites. Four of the nine were not benefited by operative treatment and died either postoperatively or within five months. Portacaval or splenorenal shunts have prevented hemorrhages and ascites in four patients for one to two years. One patient has no ascites ten years after ligation of the splenic artery, with splenopexy and omentopexy.

3. In seven patients the portal hypertension was associated with a normal liver and the patients were treated for gastrointestinal hemorrhage alone. There has been no mortality in this group. Four of these patients had had previous splenectomy, with temporary or no benefit. In four patients portacaval or splenorenal shunts were performed, with no recurrence of hemorrhage for one year. One patient has remained well for three and a half years following ligation of the splenic artery and splenopexy. Another patient with a previous splenectomy has had no further hemorrhages during the four years after the division of numerous varices and omentopexy.

4. It is suggested that splenic artery ligation be combined with the direct portacaval shunt to reduce the volume of blood flow carried by the portal system.

5. Numerous conspicuously enlarged lymphatic vessels paralleling the portal vein have been observed in every case with ascites and cirrhosis. Their significance is not definitely known but they are probably related to the increased lymph flow from the portal vein capillaries into the surrounding lymph spaces incident to the portal hypertension.

6. The recommended surgical approach for portacaval anastomosis is through a subcostal incision with vertical extensions at both ends and excision of the costal cartilage opposite the fifth interspace permitting lateral displacement of the costal margin and lateral rotation of the liver following division of the round ligament.

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A surgical room, New York City Hospital. Wheeling in the patient. A primitive scene, but note the beginning of operating room lighting. From a woodcut, 1894.

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CHRONIC NON-SPECIFIC THYROIDITIS

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CHRONIC fibrosis of the thyroid gland, not due to microorganisms and therefore designated as non-specific thyroiditis, is a subject of interest to the physiologist and clinician because of the associated hypofunctioning of the thyroid; to the pathologist because of its baffling etiology and pathogenesis and to the surgeon who must operate for the relief of symptoms of constriction and compression of the trachea and the recurrent nerve. An extensive bibliography on chronic thyroiditis has accumulated since Riedel in 1896 first described the advanced stage of this lesion characterized grossly by its so-called "eisenharte" (iron-hard) consistency and by its tendency to form firm adhesions to neighboring cervical structures, and microscopically by lymphocytic infiltration. Since Riedel's original description of chronic thyroiditis many opinions, theories and concepts concerning the etiology and pathogenesis of this condition have been propounded by various authors and investigators. However, relatively little evidence of a clinical, pathologic or bacteriologic nature has been offered to support any of the many conflicting views heretofore expressed.

Some of the theories regarding the etiology which have been advanced to explain the atrophy, deterioration, final disintegration and eventual replacement fibrosis of the thyroid parenchyma may be briefly mentioned. Between 1910 and 1920 syphilis and tuberculosis received considerable mention. Syphilis was soon discarded because of clinicopathologic criteria and evidence. Moreover, sections of the thyroid as well as animal inoculations failed to reveal the presence of tubercle bacilli. Riedel's struma had often been erroneously diagnosed as tuberculosis on the basis of the so-called foreign body giant cells which more recently were shown by the writer[1] to be epithelial conglomerates of desquamated follicular cells without phagocytic properties. They therefore could not be considered indicative of either tuberculosis or syphilis. After 1920 acute and chronic infection and non-specific granulomas were thought to play an etiologic role—without, however, supporting evidence. A search for organisms in the thyroid and cultures of excised tissue failed to support the belief that bacterial infection was an etiologic factor. Malignancy, too, received serious consideration. Finally, as reports of chronic thyroiditis became more frequent and tissue studies more searching, the roles of malignancy and microorganisms in etiology became definitely untenable.

Several authors in recent times have noted certain histologic findings in diffuse hyperplastic goiter which, it is now believed, are important first stages in the development of chronic thyroiditis. They refer to one of the commonly found evidences of inflammatory reaction in chronic thyroiditis, namely, the infiltration of lymphoid and plasma cells. Such cells also occur to a lesser extent in many cases of diffuse hyperplastic goiter. The thought arises that if the etiologic factor responsible for the lymphoid infiltration in diffuse hyperplastic goiter were known the characteristic lymphoid and other chronic inflammatory changes observed in chronic thyroiditis might be due to the very same or similar factors.

There were those (Boyden, Coller and Bugher[2]) who believed that in the thyroid the administration of iodine played a causative role in the production of lymphoid tissue and proliferation of the stroma. However, there has been no unanimity of opinion with respect to the effect of iodine. Moreover, there is no proof whatever that iodine is a factor in producing chronic thyroiditis. On the contrary, there is abundant evidence against this supposition. Stewart and Gibson[3] were apparently

[1] GOETSCH, E. Origin, evolution and significance of giant cells in Riedel's struma. *Arch. Surg.*, 41: 308–323, 1940.

[2] BOYDEN, A. M., COLLER, F. A. and BUGHER, J. C. Riedel's struma. *Tr. Am. A. Study Goiter*, pp. 35–62, 1935; also *West J. Surg.*, 43: 547–563, 1935.

[3] STEWART, G. and GIBSON, G. A. Notes on some pathological appearances in three fatal cases of Graves' disease. *Brit. M. J.*, 2: 676, 1893.

the first to describe the occurrence of plasma cells and lymphoid foci in Graves' or Basedow's disease. They regarded such findings as expressions of interstitial inflammation. Simmonds[4] could not agree and maintained that in the majority of glands containing lymphoid aggregates all support in evidence of previous inflammation was completely lacking. A. Kocher[5] was the first to emphasize the occurrence of completely formed lymph follicles with germinal centers in the thyroid of Basedow's or Graves' disease. He assumed that the lymphoid collections replaced the thyroid parenchyma and represented a kind of regenerative process in what he called "healing cases." Simmonds could not accept this view. On the contrary, he believed that as a result of the massive infiltration of lymphocytes the thyroid substance was caused to atrophy and disintegrate. The lymphoid infiltration was thus regarded as a primary replacement of disintegrated thyroid parenchyma by lymphoid tissue. This prompted Simmonds to suggest that there was a certain etiologic relationship between Basedow's disease and chronic inflammation of the thyroid. Subsequently clinical investigators and pathologists began to look to elements in the gland *per se* for the causative agents producing chronic inflammatory changes in diffuse hyperplastic goiter. They began to turn their attention from possible extrinsic to more probable intrinsic causes and from incipient focal inflammatory changes in hyperplastic goiter to the more advanced, extensive and generalized inflammatory changes present in chronic thyroiditis. Accordingly there were (1) those who believed in a possible irritative response to chemical changes in the gland;[5] (2) those who held to stimulation by an abnormal secretion which had been altered both qualitatively and quantitatively;[2] and (3) those who favored some abnormality residing in the acinar epithelium *per se*.[6,7] There were, of course, others holding opposite views who like Brünger[8] went a step further than Simmonds[4] and stated that the inflammatory changes whether toxic, bacterial or chemical in origin were the primary causes of the altered secretion. Further views concerning possible intrinsic etiologic factors were expressed. It was assumed, for example, that the chronic inflammatory reactions were a response to the irritative action of epithelial degeneration or possibly to some abnormality residing in the acinar epithelium itself. Unusual physiologic demands associated with menstruation, pregnancy or the menopause and atypical involution of the hyperplastic gland were also thought to be possible etiologic factors. However, supporting evidence for these various views was lacking.

Eventually authors began to stress the probable importance of history of hyperthyroidism, either past or present, and an elevated basal metabolic rate as significant factors accompanying chronic thyroiditis. On the other hand, others have actually denied the possible association of hyperthyroidism and an elevated metabolism with chronic thyroiditis. The confusion was doubtless due in part to the fact that the latter authors were describing the late rather than the early stages of chronic thyroiditis. We now know that hyperthyroidism does coexist with the early stages of this lesion. It is essential, therefore, that beginning stages of chronic thyroiditis as well as the advanced stage, known as Riedel's struma, be critically analyzed and defined.

In view of our present conception of the etiology of chronic thyroiditis, which will be clarified later, the reported occurrence by some authors of hypertrophic and hyperplastic parenchyma in chronic thyroiditis is of real significance.[2,9] No attempt has been made, however, to explain this association. With the hope, doubtless, of throwing some light on the pathogenesis of chronic thyroiditis other authors have attempted to explain the manner by which isolated hyperplastic follicles or clusters of follicles came to be so often sequestrated in the stroma of chronic thyroiditis. It was generally accepted that these islands repre-

[4] Simmonds, M. Über lymphatische Herde in der Schildrüse. *Virchows Arch. f. path. Anat.*, 211: 73–89, 1913.

[5] Kocher, A. Ergebnisse histologischer und chemischer Untersuchungen von 160 Basedowfällen. *Arch. f. klin. Chir.*, 92: 442, 1910.

[6] Connor, C. L. and Searles, H. H. Chronic thyroiditis, *Arch. Path.*, 10: 161, 1930.

[7] Muir, R. Text-Book of Pathology, p. 944, 4th ed. Baltimore, 1936. William Wood & Co.

[8] Brünger, H. Operationstod bei Thyreoiditis chronica. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 28: 213, 1914.

[9] Clute, H. M. and Lahey, F. H. Thyroiditis. *Ann. Surg.*, 95: 493–498, 1932.

sented parenchyma which had compensated for the destruction of secretory epithelium or which might represent regenerated epithelial structures whose function it was to replace the lost or destroyed parenchyma.[10,11] The islands were, in short, thought to be compensatory in nature. From recent studies we now realize that hyperplastic islands incarcerated in the fibrotic stroma are remnants of previously active functioning parenchymal cells which have survived from earlier stages of hyperplasia. They have therefore preserved many of the characteristics of active thyroid epithelium. They are not compensatory, for even in the epithelial islands themselves we find progressive stages of deterioration and disintegration which make it difficult, even impossible, to assume that they as damaged cells have a compensatory function. Moreover, surviving islands of active parenchyma enclosed in fibrosis are frequently found in the earlier stages of chronic thyroiditis associated with hyperthyroidism. In the presence of hyperthyroidism there would surely be no need for their secretory or compensatory activity. There were naturally those who in opposition stated that thyroid hyperplasia did not antecede chronic thyroiditis. Therefore, they maintained furthermore that thyroid hyperplasia played no role in the production of the characteristic fibrosis. In the advanced cases of chronic thyroiditis the disease had run its course; hence preoperative diagnoses could usually be made. The condition was readily recognized at operation because of the total or nearly total replacement fibrosis of the thyroid.

As frequently happens in pathologic conditions the true etiology is discovered in the early rather than the advanced stages. It seemed desirable and in fact essential to study the early histologic changes preceding the eventual stage of Riedel's struma. We, accordingly, began to search for the very earliest lesions which might exhibit suggestive criteria. The earliest findings were plasma and lymphoid cell infiltrations which frequently formed aggregates or follicles containing germinal centers. Furthermore, these mononuclear collections engulfed the thyroid epithelium and as a result of their lytic action atrophy, fragmentation and disintegration resulted. Replacement of the parenchyma by fibrous tissue characterized the final result. It became apparent to us from studies of thyroids from patients with toxic diffuse goiter that in many instances scattered foci and aggregates of lymphoid cells in association with plasma cell infiltration were encountered. The centers of these accumulations displayed isolated, small hypertrophic and hyperplastic follicles in various stages of degeneration. Incidentally, it is interesting to note that these isolated hypertrophic follicles had not been involuted by the preoperative administration of iodine. It was frequently noted that focal lymphoid areas were isolated within large areas of involuted colloid parenchyma which, however, was in no way involved in the inflammatory reaction. These foci were the earliest or incipient manifestations of the chronic inflammatory process. By a quantitative but not qualitative increase in the extent and degree of involvement in the inflammatory reaction and by coalescence of the foci of irritative reactions large zones resulted in which progressive loss of thyroid tissue with subsequent replacement by connective tissue had occurred. A series of transitions in the inflammatory process could readily be recognized. Focal areas of lymphoid circumscription of small follicles were recognized as the earliest stage. Thereupon an intermediate stage of increasing loss of parenchyma was noted. Finally progressive fibrotic changes resulting in the final stage of Riedel's struma with well nigh total loss of secretory epithelium and generalized fibrosis of the gland eventuated.

The inflammatory process manifested in the thyroids of a variety of patients with chronic thyroiditis could be advantageously divided into four stages: (1) incipient, (2) early, (3) intermediate and (4) late or advanced. It may be of interest to state briefly some of the results obtained during the past fifteen to twenty years. In the incipient group there were five children under twelve years of age; one was actually three and a half years of age. A number of young adults were also included. All the patients in this incipient group had the typical findings of toxic diffuse goiter and exact and correct diagnoses were made before operation. All of the patients in this group presented symptoms of hyperthyroidism, en-

[10] EBERTS, E. N. and FITZGERALD, R. R. Inflammatory lesions of the thyroid gland. *Canad. M. A. J.*, 17: 1005, 1927.

[11] EISEN, D. Riedel's struma. *Am. J. M. Sc.*, 192: 673, 1936.

larged hypervascular thyroids and elevated basal metabolic rates. Pathologic examination of the excised tissue showed extensive areas of involuted colloid parenchyma enclosing scattered foci of lymphocytic accumulation which surrounded and isolated hypertrophic thyroid follicles. These follicles occurred both singly and in groups and had not been involuted by the preoperative administration of iodine. They were small, contained little or no colloid and their lining cells were high columnar and contained an abundance of mitochondria. In many instances the follicular cells had already begun to show cytoplasmic degeneration. There was, however, as yet no increase in fibrosis and the degree of chronic inflammatory involvement of the parenchyma was insufficient to influence appreciably the total secretory activity of the thyroid.

In the second or early group there were eleven young to middle-aged adults complaining of typical symptoms of hyperthyroidism. In all of them the preoperative diagnosis of toxic diffuse goiter seemed clear. The thyroid glands were enlarged and hypervascular and the basal metabolic rates were elevated. Pathologic examinations showed, for the most part, large areas of colloid parenchyma involuted by iodine and not involved in the chronic inflammatory reaction. They were devoid of lymphoid or plasma cell infiltration. Scattered throughout the colloid parenchyma which predominated over the areas of inflammatory involvement there were focal areas which showed dense infiltrations of lymphoid and plasma cells occurring as formed lymph follicles or as irregular aggregates. Single or multiple thyroid follicles were surrounded by the lymphocytic aggregates and exhibited various stages of deterioration almost to complete disintegration. The cytoplasm of the follicular cells that were still intact showed an abundance of mitochondria characteristic of active thyroid epithelium. In and around the disintegrating cells the mitochondria were coalesced into irregular masses which were both intra- and extracellular. An early deposit of connective tissue, which contrasted sharply with its complete absence around the larger lobules of colloid parenchyma, was seen in the inflammatory areas.

In the third or intermediate group there were fourteen adults; most of them were middle-aged. They were slightly hyperthyroid, euthyroid or even mildly subthyroid in nature. The thyroids were enlarged, firm and frequently lobulated or nodular. The basal metabolic rates were generally within normal limits; an occasional one was slightly elevated and a few were slightly subnormal. In several cases preoperative diagnoses of toxic diffuse goiter were made, in others adenomatous goiter was suspected and in a few instances nodular colloid goiter seemed present. The variability in the diagnoses resulted because of the fibrotic changes in the gland. Pathologic examinations showed extensive areas of fibrotic involvement which in this stage predominated over the total amount of the normally involuted colloid parenchyma. The involved areas showed small islands of disoriented hypertrophic-appearing follicles which were incarcerated in the chronic hyalinized stroma. The islands of small hypertrophic follicles containing little or no colloid showed various stages of deterioration from slight to eventual complete disintegration. The more nearly normal-appearing epithelial cells preserved the characteristics of actively functioning epithelium, particularly with reference to the presence of an abundance of mitochondria in the cytoplasm. The plasma cells at this third or intermediate stage in the inflammatory process predominated over the lymphocytes. One noted in many areas fragments of disintegrated cytoplasm, the so-called Russell bodies, which had been liberated in the struggle against the irritative and destructive qualities of the hyperplastic epithelium. The arteries and veins in the hyalinized stroma were frequently seen to be occluded by organized thrombi, a circumstance which added the factor of ischemia to the other factors in the destruction of the parenchyma. The relatively large uninvolved areas of parenchyma were of simple colloid type with large follicles which were distended with colloid and lined by low cuboidal or flattened epithelium containing relatively few mitochondria. There was a striking absence of all lymphoid and plasma cells.

In the fourth or advanced and final group there were eleven patients of middle age or beyond. Their thyroids were generally quite typical of Riedel's struma. The glands were for the most part moderately enlarged and of unusually firm, so-called iron-hard consistency. They were often lobular or nodular. Consequently an occasional preoperative diagnosis of adenomatous goiter was made. More often, however, the correct preoperative diagnosis of

Riedel's struma could be determined. It is in the terminal stage that the mistaken diagnosis of malignancy is so frequently made, and this fact has led to needlessly extensive resections in those instances in which pressure symptoms such as choking, suffocation, pain or hoarseness occur. The patients in the fourth group were devoid of symptoms of hyperthyroidism; however, in a number of instances a definite history of previous hyperthyroidism was elicited. Singularly a majority of the patients in this advanced group had symptoms of hypothyroidism or even myxedema with basal metabolic rates as low as 15 to 25 or 30 per cent below the average normal. Microsopic examination of the glands revealed a virtually complete loss of thyroid parenchyma and a practically complete replacement of the parenchyma by hyalinized stroma in which there were no plasma cells and only an occasional lymphoid aggregate. Since, according to our views, the hyperfunctioning and therefore irritative parenchyma had been destroyed, no stimulating factors remained to evoke the plasma cells. However, even though architecturally organized normal thyroid parenchyma could no longer be observed, incarcerated epithelial cells occurring singly or in groups were still present in the hyalinized stroma. These cells which had resisted dissolution still exhibited mitochondria in abundance. It should be noted that the fourth or final stage is not to be confused with the so-called "burnt-out thyroid" which is technically an exhaustion atrophy with fibrosis of the entire thyroid. Chronic thyroiditis, on the other hand, is a progressive lesion beginning in focal areas of chronic inflammation in toxic diffuse goiter and continuing to involve more and more areas of the actively functioning gland until finally the entire parenchyma is destroyed. Indeed this process may well cover a period of several decades.

We believe that we have evidence to support the view that the etiology of chronic thyroiditis resides in the irritative factors inherent in the hyperplastic epithelium of toxic diffuse goiter and that these same factors are responsible *per se* for the characteristic chronic inflammatory reaction. It is always important to appreciate the true etiology of a pathologic condition in order to prescribe rational therapy. If this is done in chronic thyroiditis, the surgeon will avoid needlessly radical operations which were formerly the rule rather than the exception. Even today radical operations are occasionally performed under the impression that the lesion is malignant. The accepted treatment consists of the removal of the isthmus together with limited cuneiform resections of the lateral lobes of the thyroid, especially in the late cases exhibiting symptoms of compression or constriction of the trachea and pressure on the recurrent nerve. Because of the underfunctioning of the thyroid radical resections are obviously contraindicated.

It is interesting to speculate why all instances of toxic diffuse goiter do not terminate as Riedel's struma. This cannot be answered categorically but we are aware of similar and perhaps analogous fibrous changes in the kidney and islets of Langerhans—pathologic conditions which need not always terminate in uremia or severe diabetes respectively. It may be mentioned in passing that typical exophthalmos was absent in all of the cases which we studied. The progressive lesion apparently may halt at any stage during its course. This would be likely to occur when the hyperplastic parenchyma has been reduced to such an extent that the remaining thyroid tissue probably reverts to normal—a condition analogous to circumstances following partial surgical resections.

In conclusion, we would emphasize that the pathogenesis of Riedel's struma is revealed in progressive inflammatory changes. Essentially, as previously indicated, they are reactions provoked by the irritative factors inherent in the hyperplasia of toxic diffuse goiter. Such factors may even arise in childhood but are more prone to occur in young adults. The inflammatory changes gradually progress to more advanced lesions. Eventually they terminate in Riedel's struma which as mentioned is the product of lymphocytic and plasma cell circumscription and final isolation, incarceration and destruction of actively functioning hypertrophic and hyperplastic epithelium. The atrophy and disappearance of parenchyma is followed by progressive fibrous replacement until virtually the whole gland is destroyed. This apparently is one of nature's methods for curing hyperthyroidism. The fibrosis, at first a healing process, eventually overshoots its mark and, as similarly happens in other organs, terminates in complete destruction of the glandular elements. In short, nature may accomplish in years what the surgeon attempts in a brief operative attack.

INTRAVENOUS USE OF DILUTE POSTERIOR PITUITARY EXTRACT DURING LABOR

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PROLONGED labor is more often due to deviation from the formal pattern of uterine action required to bring about progressive dilatation and retraction of the cervix than to pelvic contraction or disproportion. The troubles and hazards of delivery are in line with the duration of labor. It is true that even considerable delay may not of itself increase maternal risk very much, yet fetal morbidity and mortality will rise. That we are in need of some security against the dangers of desultory and protracted labor there can be no doubt.

In 1945 Reid[1] after a five-year trial of small doses of pituitrin in management of prolonged labor reported excellent results. In 1946 Eastman[2] reported good results in 233 cases of severe inertia with "dramatic reduction" in the incidence of mid-forceps and Dührssen's incisions; the incidence of cesarean section was materially reduced to 3.4 per cent. Eastman considered the use of pituitary extract in minor degrees of inertia reprehensible.

In an excellent review of the American literature on the use of pituitrin before delivery Herzig[3] concluded, "The modern use of pituitrin has demonstrated that it can be a safe, efficient and superior oxytocic before delivery . . . Although one modern view sanctions the use of pituitrin in small doses before delivery with the limitation that the drug be stopped once uterine contractions have become regular, there has been evidence that pituitrin may be safely used continuously until delivery, and in this manner act as a prophylactic to the occurrence of uterine inertia or prolonged labor."

Report on the clinical use of pituitrin by intravenous drip was first made in an editorial comment by Eastman,[4] probably based on the work of Hellman which was not then in publication. In 1943 it appears that Page[5] had used the intravenous drip technic experimentally and was pleased with its physiologic response in uterine inertia; he reported no cases.

Hellman[6,7] in 1949 and again in 1950 in careful studies of the clinical value of intravenous pituitary administration in 103 cases of uterine inertia reported a failure rate of but 11 per cent, with an infant mortality rate of 3.3 per cent in his last sixty cases. The great importance of his later communication, however, is the report of parallel studies of the pattern of uterine contractility recorded by a multichannel tocodynamometer. He commended the intravenous drip as more controllable than the intramuscular method; his dilution was ½ minim diluted in 50 cc. of 5 per cent glucose in the first half hour and 100 cc. of the same mixture thereafter. Most of the labors had been conducted under regional block anesthesia. Theobald[8] stated that he had begun use of the intravenous method in 1947, and then Stone[9] reported his favorable results in thirty-two cases. Reynolds and Lubin[10] believe that rupture of the membranes is an important factor in the success of intravenous pituitrin for induction of labor. Greenhill[11] says that the Hopkins group "consider the drip technic worthless for induction of labor and moreover may lead to serious trouble."

For many years I had used posterior pituitary extract before delivery,[12] never throughout the first stage except in the treatment of ablatio placentae, nor to induce labor and never intravenously; only small doses were used, frequently as little as 0.25 to 0.125 minim diluted so as to make administration by tuberculin syringe practicable. What follows is in large measure prompted by the work of Hellman.

In January, 1949, intravenous administration of posterior pituitary extract was begun at St. Catherine's Hospital in cases of primary and secondary uterine inertia. At first the pituitary drip was stopped when good labor had been established, but as time went on its administration was continued throughout the first and second stages of labor and prophylactically through the third stage, also, if inertia had been great. It was never used in normal labor. Sedation was routinely effected with demerol and scopolamine, with reasonable care not to order

sedatives too early. Slow, controlled delivery was practiced and blood loss measured. Anesthesia was largely local block and nitrous oxide. Report of intravenous administration of posterior pituitary extract in 217 cases or 6 per cent of the total number of deliveries follows:

The effect of pituitary extract stimulation upon the fetus is of the utmost importance. The

TABLE I
FETAL MORTALITY IN 217 DELIVERIES

*Severe congenital defects	3
Hydrocephalus	
Anencephalus	
Meningocele	
*Fetal heart lost prior to pituitrin therapy	3
Abruptio placentae	
Posteclampsia	
Breech	
Intrapartum deaths	3
Short cord	
Disproportion	
Prolapse of cord	
Neonatal deaths	2
Erythroblastosis	
Separation of placenta	
Total	11

Fetal mortality 5.1 per cent

* Corrected mortality 2.1 per cent

essentials of three cases of fetal death in which it might be assumed that pituitrin therapy played a part are of interest. (Table I.)

CASE I. This patient, para 0, thirty-four years of age, had been in poor labor for thirty hours. Spontaneous delivery with episiotomy occurred four hours after administration of 1.5 minims of pituitrin in 1:10,000 dilution. The fetus, weighing 3,100 gm., could not be resuscitated. The fetal heart tones were heard shortly before delivery. Death was attributed to an unduly short cord.

CASE II. This patient, para 1, aged twenty-nine years, received 1.5 minims of pituitrin in 1:10,000 dilution. At full dilatation three hours later forceps rotation from R.O.T. to R.O.A. was accomplished. During difficult delivery of the shoulders fetal death occurred. The fetus weighed 4,512 gm. Death was attributed to failure of appreciation of the size of the fetus.

CASE III. This patient was twenty-two years of age, para 0. After forty hours of poor labor with membranes ruptured for six hours a cervical rim persisted. Pituitrin, .4 minim, in 1:10,000 dilution was given during little more than an hour. Forceps delivery from mid-pelvis, in L.O.T. and cervix fully dilated, failed. With manual rotation the cord prolapsed and the fetal heart was lost. Craniotomy was performed. The fetal weight was 3,455 gm. Death was attributed to failure of art, resulting in prolapse of the cord.

In two cases intrapartum slowing of the fetal heart was observed; in another case resuscitation was moderately difficult. In two cases in

TABLE II
RESULT OF PITUITARY EXTRACT STIMULATION (217 CASES)

	Successful	Unsuccessful	Equivocal
Not in labor, membranes intact	...	2 until membranes ruptured	..
Not in labor, membranes ruptured	42	6	5
Labor less than 12 hr.	81	5	9
Labor 12 to 24 hr.	38	3	8
Labor more than 24 hr.	14	3	1
Total	175	19	23

Percentage successful 80

which prolonged uterine contraction occurred shortly after intravenous therapy was instituted no fetal morbidity was noted.

It is difficult if not impossible to measure success with accuracy. Irrespective of the type of delivery, if a rhythmic pattern of uterine contractions were established promptly with cervical dilatation in step, it was considered a good result. If the first 1,000 cc. of dilute pituitrin solution proved ineffective or if labor began during administration of the second 1,000 cc. or even with another trial of stimulation after a period of rest, initiation of labor was thought to be coincidental with therapy not the result of it. (Table II.)

In the primary inertia group induction failed when the membranes were intact. In the presence of ruptured membranes unengagement of the fetal head, breech and the extended head were not considered contraindications to therapy since all that we hoped to do was to establish good labor. It is likely that the relationship of pituitary stimulation to the time of rupture of the membranes is an important factor in evaluation of success or failure of oxytocic therapy. A few patients had x-ray pelvimetry.

In two multiparas deep laceration of the cervix occurred with more or less precipitate delivery. In each case the accident occurred after a period of impatience in the delivery room with the cervix dilated about 8 cm. and unexpected secondary uterine inertia. In each case tetanic contraction followed a very minute dose of intravenous pituitrin. The type of delivery is shown for all 217 cases. (Table III.)

TABLE III
TYPE OF DELIVERY (217 CASES)

Spontaneous and low forceps	171
Mid-forceps or manual rotation	13
Cesarean section	7
Assisted breech	26
Total	217

The incidence of cesarean section in these 217 cases was 3.1 per cent, or less than our fairly consistent average of 4 per cent. All seven patients were primiparas and two of these had breech presentation. In four cases pituitary stimulation had failed to relieve the obstetrician's anxiety; in two of these cases the fetus was large, in one case mid-pelvic contraction was diagnosed and in two cases the fetus weighed 3,200 gm. or less. Since no report of intravenous dilute pituitrin in the management of breech presentation has appeared in the literature and since the breech is generally held to be a contraindication to this type of treatment, somewhat detailed report of twenty-eight cases follows:

Of these twenty-eight patients with breech presentation nineteen were para 0. The average duration of labor before pituitrin therapy was

TABLE IV
BREECH PRESENTATION, TWENTY-EIGHT CASES

Age of Patient (yr.)	Parity	Membranes	Hours in Labor			Minims Solution Used 1:10,000	Weight of Fetus (gm.)	Blood Loss (cc.)	Remarks
			Before Pituitrin	After	Total				
37	3	I	19	20	39	8	3,605	150	Frank breech
32	I	..	0	7	7	I	3,400	150	Frank breech
32	0	I	9	11	20	3.5	4,024†	...	Frank breech; cesarean section
31	0	I	20	2	22	.6	2,182	100	Excellent result
29	2	..	0	2	2	.9	3,900	150	No labor 48 hr.
30	0	..	30	12	42	4	4,308	300	Frank breech; good result
25	0	..	6	11	17	4	2,380	350	Good result
20	0	..	0	43	43	8.5	3,400	300	Unsuccessful
27	0	I	9	6	15	1.5	4,234	300	Poor labor before pituitrin
30	0	..	19	16	35	4	3,510	200	Secondary inertia, equivocal
38	4	..	4 days	12	..	8	Small*	400	Induction failed twice; fever
26	0	I	31	20	51	4	4,220	150	Successful
23	0	..	26	8	34	2.3	3,170	250	Fair result
31	0	..	18	18	36	4	3,525	250	Fair result
25	0	..	15	10	25	4	3,400	100	Excellent
23	0	..	12	8	20	3	3,170	150	Excellent; frank breech
35	4	..	12	1	13	.3	3,060	100	Footling; excellent
36	0	..	0	4	4	.5	2,830	100	Good result
27	0	..	6	4	10	1.5	3,060	150	Good result
30	0	..	8	7	15	1.5	4,140†	...	Frank breech; cesarean section
21	0	..	14	3	17	1.5	3,020	150	Frank breech; good result
25	0	..	0	9	9	2.5	Small	250	Frank breech; good result
39	2	..	0	5	5	2	2,890*	700	Ablatio; good result
29	0	..	4	3	7	I	.....	200	Good result
31	2	I	0	4	4	3	3,500*	...	Ten days after eclampsia
30	I	..	0	3	3	...	3,400	150	Frank breech; good result
24	I	..	6	4	10	...	3,400	200	.....
27	0	..	11	2	13	.6	4,025	400	Fair result

* Stillbirth
† Cesarean section

ten hours if one patient stated to have been in desultory labor for four days is eliminated from the calculation. Induction had failed twice. The average duration of labor afterward in twenty-eight cases was nine hours. Three infants were born dead; in no instance could death be attributed to pituitrin stimulation of labor. (Table IV.)

COMMENTS

Protracted labor is common. Good management of ineffective labor is of the utmost importance. Antibiotics help us a great deal; however, they cannot be relied upon with certainty. No doubt patience and time will solve many obstetric problems, yet delay often raises new questions.

It is hard to imagine that more criticism and prejudice has ever been poured out upon a single subject than upon the use of an oxytocic before delivery. I enter this field of disorder with some misgiving.

Clinically the physiologic pattern of labor has been well maintained and controlled by use of intravenous infusion of dilute posterior pituitary extract, whether pitocin or pituitrin, in patients with marked uterine atony. The drip dilution used was 1:10,000 as recommended by Hellman. In a few cases a 1:5,000 dilution was used but with no better effect. In primary inertia ruptured membranes appeared to be a requisite for success. This was not true of secondary inertia; in the course of stimulated labor intact membranes occasionally presented at the vulva.

No observer has reported any undue fetal mortality. Satisfactory results have been very welcome and no harm has resulted from failures. Almost always functionally pathologic labor may be easily recognized clinically. The pattern of labor should be good and cervical dilatation should keep pace with it. If it does not, labor is probably obstructed. The value of good x-ray pelvimetry is admitted yet it is not widely available.

It is true that mid-plane diameters cannot be measured unless by x-ray. A promontory that is easily reached or prominent spines point to mid-plane obstruction. Fortunately cesarean section may not become necessary because of moderate mid-pelvic contraction. Good labor is often better than forceps.

In breech presentation delivery by cesarean section is indicated even if any degree of disproportion is likely. The experienced obstetrician looks upon breech with some concern. The fetal head in the fundus cannot be reliably measured. It is apt to feel and look larger than it really is. It is not always simple to estimate the size of the fetus in breech presentation, yet it should not be difficult to say that the fetus is large or small. In the primipara fetal risk depends largely upon the size of the fetus, yet fortunately in only a small percentage of cases does the fetus weigh more than 3,600 to 3,800 gm. The principal cause of fetal death is intracranial hemorrhage due to the risk associated with pelvic delivery; however, this does not mean that cesarean section is the best answer.

The breech is usually not engaged at the onset of labor, and early rupture of the membranes is common. With good labor if the breech should descend into the pelvis successful delivery may be expected if the fetus is not large. Failure of good pituitrin response or absence of descent with it make the prognosis of delivery easier.

Provided the patient is carefully observed, dilute posterior pituitary extract by intravenous drip may be safely and continuously used throughout labor whether for induction or to stimulate labor that has stopped after spontaneous onset. It is probably not safe for the multipara of high parity. It is not contraindicated in breech presentation.

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INDICATION FOR GASTROENTEROSTOMY

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IN the early development of gastric surgery in this country gastroenterostomy was the treatment of choice for duodenal ulcer by the prominent surgeons of that era; subtotal gastrectomy employing the Billroth (1) and Billroth (2) methods was reserved for cancer of the stomach by such master surgeons as the Mayos, Crile, Murphy, Deaver and others. Sleeve and V resections for gastric ulcers followed with gastroenterostomy were also advocated by these men who believed that gastroenterostomy was necessary because so much of the musculature of the stomach was removed by these methods that drainage through a gastroenterostomy stoma was an essential part of the operation. It was noticed at that time that marginal ulcer rarely ever followed the operation.

Surgeons visiting the Continent soon after World War I were surprised to find the Continental surgeons employing subtotal resection for duodenal ulcer; the reason given was that multiple ulcers accompanied with chronic gastritis were present in so many of their cases. The writer spent a week with Finsterer, one of the first who strongly advocated radical subtotal gastrectomy for duodenal ulcer, and saw him operate upon seven patients with duodenal ulcer. In three of these cases the ulcer was firmly adherent to the pancreas and so close to the common duct that Finsterer used the exclusion resection, which is still good for certain complicated cases if the gastric mucous membrane is removed as advocated by Bancroft.

It was noticed in those early days that the patients who received permanent relief after gastroenterostomy was performed were those of the older age group, having had symptoms for many years with low acids and interference with the emptying power of the stomach. A correctly performed gastroenterostomy with postoperative medical supervision was an excellent operation then as it is today.

If a marginal ulcer did not develop in such a patient after two years had elapsed, the patient was thought to be permanently cured. It is well known today that a marginal ulcer may develop many years after the gastroenterostomy.

Gray reports that gastroenterostomy is employed in 25 per cent of the cases of duodenal ulcer in the Mayo Clinic but emphasizes that these cases must be chosen with great care.

There are several reasons why gastroenterostomy has been discredited in the minds of many, the first being that it was incorrectly employed for small duodenal ulcers in young patients with high acids whose symptoms were all increased by emotional strain. It was also used for ulcers which were supposed to be present but which could not be demonstrated at the time of operation, and by a group of general practitioners who operated upon their own patients and who believed that if they could perform a gastroenterostomy they would belong to the group known as master surgeons. The writer recalls disconnecting a gastroenterostomy performed between the posterior wall of the stomach and the transverse colon, another between the stomach and the lower jejunum and another between the posterior wall of the stomach and the terminal ileum 3 inches from the ileocecal valve. The operator, not a surgeon, had mistaken the fat tag at the terminal ileum for the ligament of Trietz. Is it any wonder that such judgment and such operations brought discredit to gastroenterostomy?

The mortality of this operation for duodenal ulcer should be less than 1 per cent. The mortality for subtotal resection performed by excellent surgeons is between 4 and 5 per cent.

The whole question is a moot one because many excellent surgeons maintain that subtotal resection is the only logical operation to be used in the treatment of duodenal ulcer whereas others with wide experience in gastric surgery still maintain that gastroenterostomy is a safe and curative operation in a certain percentage of well chosen cases.

The question of gastroenterostomy and vagotomy for the treatment of duodenal ulcer

has many advocates. The author believes that the operation may be employed in many cases with success but that sufficient time has not elapsed to have a full evaluation of the end results of this method.

The author believes with many others that the patient with a small marginal ulcer should have the stoma of the gastroenterostomy disconnected and subtotal gastrectomy performed if it can be done safely. If not, a vagotomy should be performed. The writer also believes vagotomy is best used in that case in which a marginal ulcer develops following subtotal gastrectomy.

STEREOSCOPIC RADIOGRAPHY IN THE DIAGNOSIS OF ANORECTAL FISTULA

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LET us recall the difference between a fistula and a sinus. A fistula is a tract or channel connecting two surfaces such as the anal canal with the perianal skin, rectum or other contiguous organs. A sinus is a tract or channel draining on one surface only. An external sinus would drain on the skin whereas an internal sinus would open into the canal. An anal fistula usually originates in an infected anal crypt, duct or gland and opens almost always on the skin surface. A fistula, however, may be connected also with an abscess located either between the anus or/and rectum and vagina, bladder or urethra. A fistula may also be of pelvic or abdominal origin. It may follow and complicate such diseases as appendicular abscess, pyosalpingitis or other pelvic suppurative disease or it may be an ileorectal fistula. Necrotic bone disease of the pelvis, head of the femur or even of the vertebra has been found the source of fistulas. Usually the external opening was located in the perirectal region or perineum. It is obvious to anyone who deals with many cases of fistula that the textbook "goose-quill" direct type of channel between the perianal skin and the anal canal or rectum is the exception rather than the rule.

Many so-called simple direct fistulas are said to *recur* after operation when really the fistula still persists because some side tracts or branches were never discovered because the diagnosis was made by the probe type of examination. The use of stereoscopic radiography after the injection of an opaque fluid or paste would have prevented and obviated this diagnostic error and would have saved the patient multiple unnecessary operations and needlessly prolonged surgical treatment.

In other words a simple fistula is not so *simple* until it has been proved so by all of the diagnostic means at our command. The extra trouble and the slightly added expense of radiologic consultation will pay off in the added assurance of a sure and complete diagnosis and the insurance against those so-called recurrences and reinfections. There is also the satisfaction to both the patient and his physician following complete eradication of the fistula and the restoration of sphincteric function without unnecessary multiple surgical and hospital expense. We have seen many patients who have undergone numerous operations for fistula who gave a history of never having been free from wounds discharging pus after many attempts at operative relief. Not until the persistent remaining and unsuspected and undiscovered side tracts, branches or cavities were discovered by the employment of stereoscopic radiography were these patients entirely relieved of their fistulas.

Before submitting to the temptation of inserting a probe into an external opening and advancing it even very gently and with a minimum amount of force through what seems to be a straight simple channel it would be far better to inject a solution of hydrogen peroxide, either plain or mixed with methylene blue, or some warmed bismuth paste to determine the presence of an internal opening or the possible communication with adjoining cavities or contiguous organs.

The use of a stiff wire probe, or worse, a grooved director, is too often responsible for the transformation of a simple direct fistula into a multiple or complicated one. This can be caused by the formation of false passages due to trauma caused by the forcible introduction of a hard, unyielding instrument into a channel which is ordinarily curved or tortuous. A stiff probe may also be responsible for the accidental creation of a new and false opening into the bowel. The probe penetrates the walls of the cavity into the surrounding tissues and will cause a spreading of the infection into hitherto non-infected areas. If one believes one must employ a probe, it is much safer and less liable to traumatize the fistula walls if one uses a probe made of soft, annealed silver suture wire. It is easy to make one of ordinary suture wire of the desired caliber and to fuse each end into

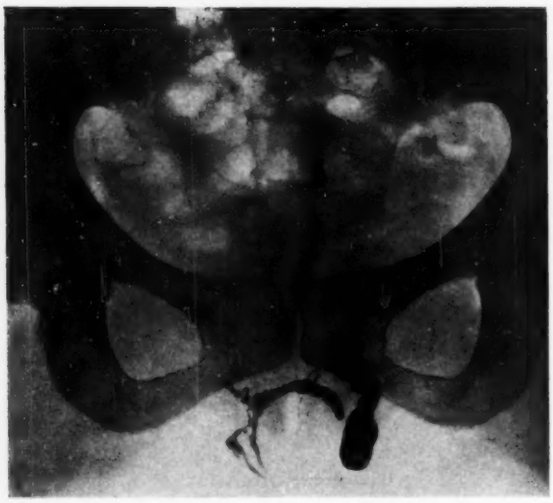

FIG. 1. Multiple fistula injected with bismuth paste (stereoscopic).

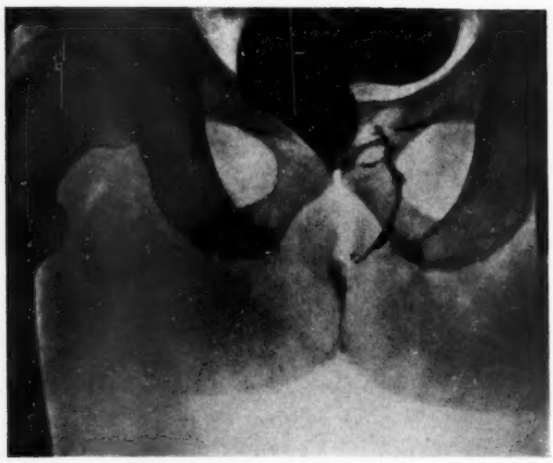

FIG. 2. Multiple fistula injected with bismuth paste; barium enema in addition (stereoscopic).

a ball over a Bunsen burner. This type of soft, pliable probe will accommodate itself to the irregularities and tortuosities of the cavity walls and is much less liable to create traumatic passages. The probe is really an unnecessary diagnostic instrument but this type of a soft silver one is of real value in the operative treatment of fistulas.

Palpation and the injection of a colored solution or paste through an external opening will if carefully watched usually disclose the exact location of the internal opening. Usually the paste or solution will be found emerging through a diseased anal crypt and more often in one of the posterior quadrants. We have found in our experience dealing with thousands of fistulas that in multiple complicated or so-called recurrent types the diagnosis can be made much more satisfactorily by the employment of radiography and especially stereoscopic radiography.

In the preparation of the patient for his radiographic study it is quite important that the bowels be thoroughly emptied and cleansed. We believe it is best to do this with a warm enema containing sodium bicarbonate or sodium chloride in weak solution or by the use of simple tap water. We never use soapsuds and do not believe in upsetting the intestinal tract by the employment of cathartics of any kind. For the preparation of fistulas for radiography we prefer an opaque paste such as bismuth paste to an oil such as lipiodol. One reason for this is that oils are not well retained and usually leak out of side tracts or escape into the rectum while the paste, which loses its fluidity at body temperature, will remain inside the fistula. Digital pressure on a paste-filled cavity will cause the paste to emerge from an opening and give valuable information as to the location of any connecting cavity or side tract.

Bismuth paste, which consists of one part of bismuth subnitrate to two parts of yellow petrolatum, has proved in our hands the ideal opaque material to use, especially for this diagnostic study of anorectal fistulas. The technic for the injection of fistulas for stereoscopic radiography is not particularly difficult but some simple details are important. It is essential that one employ the proper type of syringe. We have found that a glass sinus syringe with a curved shank surmounted by a conical tip has been ideal for this injection. The use of cannulas or fine rubber tubes or catheters inserted into the fistulous opening should be deprecated because superficial or subcutaneous tracts and channels can easily be by-passed and the value of this method of examination completely nullified.

The syringe is filled with bismuth paste which has been heated to approximately 110°F. At this temperature it is fluid and easily injected.

The patient is placed in the prone or left lateral position. If there is more than one external opening seen, usually the largest or one located most nearly in the right or left posterior quadrant is employed for the injection. The tip of the syringe is placed against this external opening and the paste slowly

injected. This bright yellow paste will soon be seen emerging from one of the other external openings, if present, and usually from the anal aperture. If a considerable quantity of paste is injected before any appearance externally, it may be assumed that the paste is either entering the rectal cavity from an internal opening or it is reaching one or more cavities surrounding the bowel which are the remains of the parent abscesses.

If the fistula connects with the vagina, urethra or bladder, the escape of the paste into these organs will soon be manifested by its failure to emerge immediately. However, in rectovaginal fistulas the paste soon makes its appearance at the external introitus. (Fig. 1.)

It is usually necessary to wipe the excess paste gently from the rectal cavity before making the films and all excess paste should be gently wiped from all of the surrounding cutaneous surfaces before proceeding to the making of the films. Lateral and anteroposterior flat films as well as the stereoscopic exposures should be made, and not infrequently a barium enema should be administered after the first set of fistula films have been made. This will prove of added value in determining the location of fistulous cavities around the bowel above sphincter level. Internal sinuses or those which open only inside of the anorectal canal are best injected under direct vision through an anoscope. In painful or sensitive conditions it may be necessary to relax the sphincter under regional or caudal anestheisa. (Fig. 2.)

It is probably true that in very simple direct subcutaneous fistulas between the anal canal and perianal skin this radiographic study may be unnecessary and superfluous. It is, however, of the greatest value in discovering unsuspected and often overlooked side tracts, channels and cavities that have been responsible for many operative failures, incorrectly blamed as recurrences and re-infections. This three-dimensional projection of a multiple or complicated fistula furnishes the proctologist or surgeon with a blueprint of the entire fistulous layout for his guidance in the surgical eradication of a serious and troublesome disease condition. This is vastly superior to the haphazard injections of colored dyes or fluids at the time of the operation.

It is often of distinct advantage at the time of operation to reinject the fistula with bismuth paste either in its quite bright yellow color or tinted with methylene blue or gentian violet. This will prove of advantage in disclosing small secondary openings which can be easily compared with the films in the stereoscopic viewing frames.

In our own practice we have been consulted by a large number of patients suffering from so-called recurrent fistulas. Some of these unfortunate individuals have undergone as many as seventeen or eighteen operative procedures without having been free from their symptoms of fistula. These patients had never had the benefit of a complete study of the entire fistulous set-up until stereoscopic radiography was employed. Although the surgical relief of anorectal fistulas requires considerable specialized surgical skill, much of this skill is wasted unless the true picture of the fistula in all of its ramifactions and communications is recognized in advance by the operating surgeon. In spite of all of our diagnostic advances and modern surgical technic the conservation of sphincteric function and the prevention of impairment of bowel control is usually a serious problem.

However, if the patient has had a stereoscopic radiographic study before he has been subjected to any attempt at surgical relief, he can consider himself extremely fortunate. The employment of this method of diagnosis will often convert what otherwise might be an operative failure into a surgical triumph.

CARCINOMA OF THE MALE BREAST

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CARCINOMA of the male breast occurs so infrequently that large series of cases are lacking. This, no doubt, has accounted for the discrepancies in the prognosis of this disease. Because the outlook is so dependent on good surgical and medical care we feel justified in presenting our small group of five cases, four of whom have had at least five-year follow-ups and one died three years and eight months after operation from metastasis. It is our desire to correlate with previous reports the pertinent points that will lead to an early diagnosis and improved prognosis.

REVIEW

Although reference to male breast carcinoma was made by Ambroise Pare in the early part of the sixteenth century, it was Fabricius Hildanus[1] (1537–1619) who described the first single case. In the following century many individual case reports were added to the literature. However, not until 1889 were any significant series reported by Williams.[2] Since his report the most notable papers have been presented by Wainwright,[3] Neal,[4] Sachs[5] and Gilbert.[1] A most excellent contribution was noted in the pathologic investigation of Neal. In 1944 Peck[6] reviewed the literature and in addition reported fifteen cancers of the male breast in a total of forty-three tumors. In 1949 Payson and Rosh[7] reported twenty-five cases collected from the surgical service at Bellevue Hospital. Shortly following the above report Treves[8] collected thirteen cases in which male castration was used as an adjuvant to the already standard treatment.

OBSERVATIONS

The incidence of carcinoma of the male breast seems to vary little among authors. Approximately 0.14 per cent of all cancer in males is due to cancer of the breast.[1] According to Neal[4] 1.24 per cent of all carcinomas of the breast occurred in males in a series of 9,279 specimens. His statistics are in agreement with most authors. The average age in the larger series reported varied little from 57+ years. The youngest case reported was that mentioned by Sachs[5] occurring in a child of twelve years. The oldest case in the literature was that of Wainright[3] in which he reports carcinoma in a male ninety-one years old.

The etiology of this disease is that of carcinoma elsewhere and is purely speculative and highly debatable. The question of trauma was considered in the series of Gilbert[1] and Sachs[5] in which 29 and 23 per cent, respectively, revealed a history of trauma. However, Neal's[4] series invalidates the importance of trauma as an irritating factor.

The significance of heredity in carcinoma has been accepted by many clinicians as well as researchers. This has been emphasized by the experimental work of Little[9] and his co-workers in which he transferred the fertilized ovum of a low cancer-bearing strain of mice to the uterus of a high cancer-bearing strain with the subsequent increase in incidence of breast cancer in the low cancer strain. In addition, Williams[2] noted the family relationship in carcinoma of the male breast. In the main, the statistics related in this phase of work are so variable that their significance cannot be thoroughly evaluated. It is the consensus of opinion, however, that heredity is an additional enhancing factor in the development of cancer but does not explain the majority of cases.

The relationship of gynecomastia to the incidence of carcinoma of the male breast has been one of long-standing interest. Gilbert[1] was of the impression that gynecomastia reflected hyperactivity and overdevelopment due to increased estrogenic activity and, therefore, believed that it was a predisposing factor in carcinoma. He showed an association of this condition in nine (or 19 per cent) of his total forty-seven cases of carcinoma of the male breast. On the other hand, Geschikter[10] demonstrated only three cases or 10 per cent of associated gynecomastia and carcinoma of the male breast. In addition, Geschikter[10] differentiated three types of gynecomastia which are seen

clinically and are of importance in the differential diagnosis.

Symptoms. The symptoms of carcinoma of the male breast are not unlike that of female breast neoplasm. In the 205 cases of Sachs[5] nipple retraction was evident in 33.1 per cent. Pain, which was a relatively common complaint, was present in 38.1 per cent of cases, bleeding from the nipple in 14.5 per cent and ulceration in 20.6 per cent. Approximately 50 per cent of the cases revealed a mass in the breast as the cause for medical aid. The duration of these symptoms reflects one of the reasons for the prevailing prognosis. Sachs[5] stated that in his series an average of 1.14 years intervened from the time of awareness of the symptoms until the seeking of medical help. In Gilbert's[1] forty-seven cases 2.05 years was the average interval of neglect. In our small group symptom duration varied from one week to nine years, one patient waiting four years and two patients six months before consulting a physician. In the face of the long delay in seeking a diagnosis the high incidence of regional metastases is not difficult to understand. In Sachs' series approximately 46 per cent presented axillary involvement; 32 per cent of Neal's cases when first examined revealed regional glandular involvement. In spite of the variation of axillary involvement with the type of carcinoma present the incidence is still quite high.

Differential Diagnosis. As a rule the diagnosis of carcinoma of the male breast should not be a difficult one. A careful history and physical examination is no less important here than in any diagnostic problem. However, the biopsy should be the final step in every breast case. In the absence of ulceration other tumors of the breast must be considered. Acute infectious mastitis or abscess are rare as shown by the reports of Neal and Simpson.[11] Although these may follow a history of trauma, they are more likely to represent a complication of an acute infectious process such as typhoid fever, mumps, septicemia, syphilis or tuberculosis. Biopsy and pathologic study are the only diagnostic procedures of accurate detection and their consideration here in the differential diagnosis should be of an academic nature only. Chronic mastitis may follow acute mastitis as organization of an exudate or as a localized sclerosing repair process or may present a chronic inflammation from the onset. It may be of a diffuse nature or localized, or in multiple areas giving the sensation of a hard nodule or nodules. These are usually painful. The chronic cystic type of mastitis is a rare finding in the male breast since it is not a secretory organ. Gynecomastia or true hypertrophy of the male breast presents a variety of clinical pictures which are well described by Geschikter[10] who has divided it into three forms. One is the diffuse hypertrophic form which is often seen early in puberty, the enlargement being moderate and consisting of hypertrophied mammary tissue without marked increase in the surrounding fatty tissue. This puberty type is painful in about 30 per cent of cases. The type found in adults is of a more chronic nature and is classed as the adenomatous type in which there is a more definite nodularity and can be distinguished from carcinoma only by excision. The rarest form of gynecomastia is that in which true feminization occurs, the size of one or both glands approaching that seen in the adult female. In this group careful examination may reveal a tumor of one of the endocrine glands. Cysts in the male breast are extremely infrequent. According to Neal and Simpson[11] they are usually due to one of two processes: (1) If new glands are formed which do not connect with the ducts and there is subsequent cellular activity, the products may be retained; (2) on the other hand, this same condition may exist if the excretory ducts are stenosed by an inflammatory process. Other rare lesions of the breast may occur such as sebaceous and dermoid cysts, hemangiomas, lipomas and lymphangioma.

Pathology. The pathology of carcinoma of the male breast does not vary greatly from that in the female. The basic elements involved are those arising from the glandular portion and those arising from the nipple and skin. The adenocarcinomas develop from the glandular portions of the breast and these are subdivided into the scirrhous, papillary, medullary and mucoid carcinomas. Of the epidermoid carcinomas there are the so-called Paget's disease, squamous cell carcinomas, basal cell carcinoma, melanoma and so-called sweat gland cancer, the latter being relatively rare. In our series four cases were of the adenocarcinoma group and one of the epidermoid group. Of the two groups it has been noted that the adenocarcinoma of the scirrhous type is generally the most malignant. Other than this conclusion from larger collected series of cases one can find no relation-

FIG. 1. Case 1. Grade 1 epidermoid carcinoma.

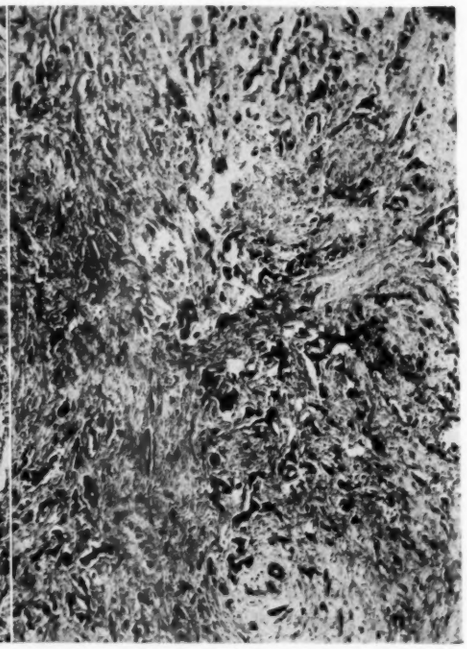

FIG. 2. Case II. Grade 3 adenocarcinoma (scirrhous type).

ship of the type or grade of the carcinoma to the prognosis.

Treatment. The infrequency of cancer of the male breast has been the cause of hesitation in excision of male breast tumors for the necessary histopathologic studies. As in cancer of the female breast an early diagnosis and radical surgery are indicated. One must thoroughly evaluate the physical status of the patient as well as the extent of the growth. An important factor today which reflects surgical advance is new anesthetic technics. This is of significance since malignancy occurs in the sixth decade of life (majority of cases) during which period the cardiac and vascular status are of paramount importance.

CASE REPORTS

CASE I. A. S., hospital No. 1348, a sixty-one year old male, thirty years prior to entry had noticed an accessory nipple 3 cm. cephalad to the normal right nipple. Nine years previous to entry he noticed that the nipple was two or three times enlarged and tender. A local physician incised the mass and obtained nothing but blood. The lesion failed to heal completely during the ensuing nine years but did not increase in size.

Physical examination revealed a mass in the right breast (3 by 3 cm.) over which the skin was covered with a bloody crust. Axillary glands on the right were moderately enlarged.

On April 16, 1932, a right radical mastectomy was performed. Postoperatively his course was good and the incision healed well.

The pathologic report (No. 388) revealed grossly that just above the nipple and lying directly under the skin a 1.5 by 1.5 cm. mass was present. The latter was elevated, indurated, ulcerated and on cross section yellow, hard and sharply limited. The axillary lymph glands were enlarged. Microscopically, a grade 1 epidermoid carcinoma (Fig. 1) was present with a chronic lymphadenitis of the axillary glands and no carcinoma evident. Twelve years following operation the patient was alive and well without evidence of local recurrence or distant metastasis.

CASE II. E. W., hospital No. 133951, a seventy-two year old male, became aware of a "fullness" in his left breast one week before admission and noticed that the nipple was somewhat retracted. There was no history of pain or bleeding.

Physical examination revealed a mass in the left breast (2 by 2 by 1 cm.) lateral and superior to the nipple which was moderately retracted. No enlargement of the axillary glands was felt.

On February 10, 1942, a left radical mastectomy was performed. Grossly there was no

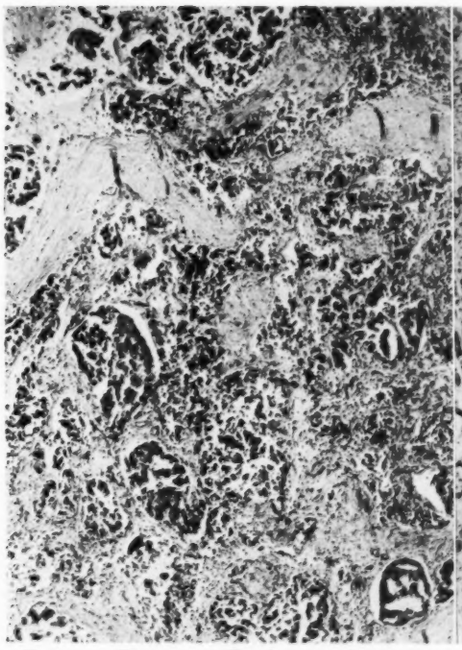

FIG. 3. Case III. Grade 3 adenocarcinoma.

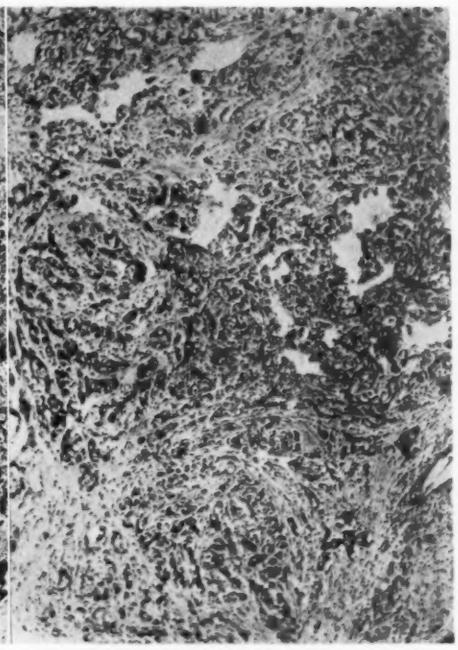

FIG. 4. Case IV. Grade 3 scirrhous carcinoma.

evidence of malignancy in the lymph nodes of the axilla. The patient's postoperative course was uneventful and the incision healed well.

The pathological report (No. 214-42) revealed that a mass 1.5 cm. in diameter was present posteriorly and just above the left nipple. The mass was very hard and faded out into the surrounding tissue. There were a few small nodes present which grossly did not show tumor. Microscopic examination revealed a grade 3 adenocarcinoma (Fig. 2) without axillary lymph node metastasis (scirrhous type).

A total of 6,350 r measured in air was administered through the usual four ports* from February 18 to March 20, 1942. The patient died three years and eight months postoperatively of spinal metastasis.

CASE III. F. B., hospital No. 8110, a fifty-six year old male, first noticed a lump under the right nipple very shortly following trauma to the same area four years before entry to the hospital. The mass had since been slowly enlarging. There was some soreness present over the right breast from irritation by suspenders but there was no history of bleeding from the nipple.

Physical examination revealed a firm 1.5 cm. in diameter nodule which was immediately posterior and attached to the right nipple. There were numerous hard, moderately enlarged lymph nodes in the right axilla.

On June 18, 1943, a right radical mastectomy was performed and numerous firm, enlarged lymph nodes were found in the axilla. The postoperative course was uneventful with good healing of the incisional wound.

The pathologic report (No. 1096-43) revealed grossly a hard mass (1.5 by 1.5 by 1.5 cm.) attached to the undersurface of the nipple and also adherent to the muscle sheath. Eight firm lymph nodes, moderately enlarged, were found in the axillary tissue. Microscopically, a grade 3 adenocarcinoma (Fig. 3) was present with metastasis to at least one axillary lymph node.

The patient was alive and well without evidence of recurrence or metastasis six years after operation.

CASE IV. H. H., hospital No. 17346, a thirty-nine year old male, became aware of a lump in his left breast six months prior to admission. Three months before entry the patient noticed that the left nipple was somewhat retracted. There was no history of pain or bleeding from the nipple.

Physical examination revealed the presence of a fairly well circumscribed nodule, very hard, approximately 1.5 cm. in diameter, located just posterior to the left nipple, the latter being

* (1) Breast, (2) anteroposterior axillary, (3) posteroanterior axillary and (4) supraclavicular.

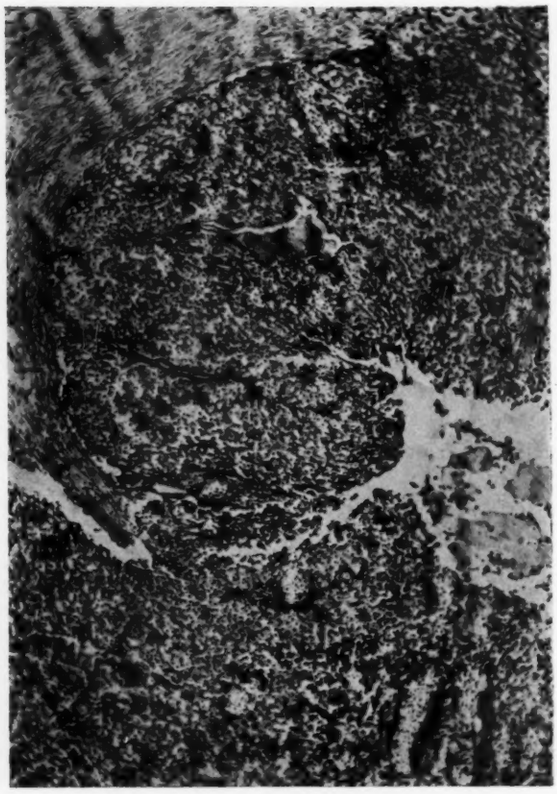

FIG. 5. Case v. Papillary carcinoma.

moderately retracted. There were numerous hard, shotty-feeling lymph nodes in the left axilla.

On November 17, 1944, a left radical mastectomy was performed with the removal of numerous grossly enlarged axillary lymph nodes. The patient's postoperative course was uneventful, with good healing of the incision.

Pathologic report (No. 2153-43): The specimen consisted of a male breast and the adjacent axillary contents. A hard mass 1.5 cm. in diameter was present just posterior to a retracted nipple. The tumor could be seen grossly infiltrating the surrounding tissue and involving the nipple. Grossly, one of the several enlarged lymph nodes appeared to be invaded by tumor tissue. Microscopic examination revealed a grade 3 scirrhous carcinoma (Fig. 4) with metastasis to two of five axillary lymph nodes.

A total of 5,760 r measured in air was administered in a period of three weeks through the usual four ports to the region of the left breast and axilla.

The patient was alive and well five years after with no evidence of recurrence or metastasis.

CASE V. J. M., hospital No. 17819, a fifty-seven year old male, noticed that his left breast was somewhat tender and appeared to be diffusely enlarging six months prior to admission. The breast had gradually continued to increase in size. There was no history of bleeding from the nipple or pain in the left breast.

Physical examination revealed a mass 3 cm. in diameter which was hard, fixed to the underlying skin and located just inferior to the areola. There was no evidence of axillary node enlargement.

On December 15, 1944, a left radical mastectomy was performed. His postoperative course was uneventful.

Pathological report (No. 2323-44): The breast contained a cyst 3 cm. in diameter in which there was a papillary tumor measuring 1.5 by 1.5 cm. There were several small axillary lymph nodes which grossly did not appear to be involved by tumor. Microscopic examination revealed a typical papillary carcinoma. (Fig. 5.) Section of several axillary lymph nodes showed no evidence of metastasis.

A total of 5,640 r measured in air was administered over a period of three weeks through the usual four ports to the region of the left breast and axilla.

The patient was alive and well five years after with no evidence of recurrence or metastasis.

COMMENT

Radical mastectomy was done in all of our five cases. Four were living and well at least five years after operation. Of these four, one was living and well twelve years after surgery, one six years and the other two five years after operation. One patient who had a grade 3 adenocarcinoma without axillary lymph node metastasis and who received postoperative radiation therapy died three years and eight months postoperatively of spinal metastasis. Two of the three patients who received radiation therapy are alive and well five years after operation. Of these two, one had axillary involvement. Of the two patients who did not receive postoperative radiation one is alive and well six years after operation. The other had no recurrence after twelve years but was unable to be followed after 1944.

Radiation therapy prior to radical excision no longer is justified according to the results reported in the literature and from those results presented by Pack and Livingston.[12] Post-

operative radiation, however, can be considered a true adjuvant in the therapy of carcinoma of the male breast and especially when metastatic carcinoma in axillary glands is present. Here one should treat the mediastinal lymph drainage because of the rapid degree of metastasis which may occur through a thin chest wall and little breast tissue. Since Cheatle and Cutler[13] found involvement of the axillary nodes in approximately 60 per cent of the cases, it is essential that the axillary as well as the supraclavicular areas be considered in roentgen therapy. Since Speese[14] reported invasion of the pectoral fascia in 35 per cent of his cases and involvement of the pectoral muscle in 25 per cent, one can readily see the reason for the poor prognosis and necessity for using all the agents we possess in attempting to alter the outlook. In the presence of distant bone metastasis the question of orchiectomy must be considered since the work presented by Farrow and Woodard[15] in which they demonstrated that injecting testosterone proprionate into male patients with breast carcinoma and skeletal metastases increased the serum calcium and caused evidence of increased activity of bone metastases. The question arose as to the efficacy of removal of its source of hormone by orchiectomy. Leucutia[16] attempted bilateral orchiectomy in two cases of male breast cancer with distant metastases. One of his patients was symptom-free four months later and x-ray revealed disappearance of the metastatic lesions with recalcification of the destroyed areas. Two years later he was still free of any metastasis. The second case showed only temporary improvement. Payson and Rosh[7] report a bilateral orchiectomy in one of their cases in which the patient was bedridden because of severe pain. Three days following the operation pain was completely relieved and in three weeks the patient was up and about in the wards. In March, 1949, Treves reported thirteen cases in which castration was performed and it was his belief that bilateral orchiectomy had definite favorable effects on primary inoperable neoplasms as well as in promoting healing in osseous metastases. He found that the average number of months survived in patients with remote metastases on admission was thirty-one months. In the non-orchiectomized group it was only ten months; however, it was his belief that his series was too small for a reliable comparison. His work, however, is an incentive for further work in this direction.

PROGNOSIS

The statistics by various authors as to "five-year cures," is indeed distressing. In the series of cases (163) reported by Wainwright only 19 per cent survived five years. On the other extreme Sachs showed a five-year cure of 47.8 per cent. In spite of this marked variation of percentage survivals it is apparent that the majority of statistics reflects a very depressing picture with an average of 20 per cent over-all five-year survivals. If one compares this with five-year survival rates in the female, it is apparent that the prognosis is poorer in the male. In seeking an explanation one sees several possible attributing factors: (1) the failure for early recognition by the patient, (2) failure of the physician to realize the potentialities of a mass in the male breast and (3) the increase in percentage of axillary metastasis due to the anatomy of the male breast with the lack of breast substance for surrounding extension before metastasis.

The effect of postoperative radiation on lengthening the span of life has been a debatable subject due to the poor collection and evaluation of the prevailing statistics. In spite of this inadequacy in follow-up cases the consensus of opinion is unanimous in its favor. Three of our cases were treated in the usual manner with approximately 5,000 to 6,000 r over the routine portals.

In cases of metastasis to the osseous system orchiectomy seems to have something to offer. Treves has shown a gain of twenty months in these cases in comparison with a group of controls. In spite of his small series the results are encouraging and in face of the distressing prognosis of male breast carcinoma, orchiectomy should be contemplated in this group of cases.

SUMMARY

1. Since carcinoma of the male breast occurs so infrequently, large series of cases have been lacking. Therefore, we believe we are justified in presenting our series of five cases, four of which have at least five-year follow-ups.

2. Approximately 0.14 per cent of all cancer in males is due to cancer of the breast.

3. The high incidence of regional metastasis

is probably largely due to delay upon the patient's part before consulting a physician.

4. One can find no definite relationship of the type or grade of carcinoma to the prognosis.

5. Postoperative radiation can be considered a true adjuvant in the therapy of male breast carcinoma, especially when metastatic axillary glands are present.

6. In the presence of distant bone metastases orchiectomy has been shown by Treves to be of definite value in lengthening life span and alleviating pain.

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TUMORS AND CYSTS OF THE NECK*

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THE subject of tumors and cysts of the neck is one about which volumes have been written. It is one of the most fascinating, yet puzzling, subjects confronting the internist, surgeon and pathologist. Much has been discovered about these lesions but a great deal more remains to be learned about them. Possibly in no other part of the body do so many distinct pathologic entities occur in so small an area.

In recent years I have advocated the streamlining of medical papers, but an attempt to apply this method of discussion to a subject of such magnitude is to tax one's ingenuity. Of necessity, one can merely outline the subject, emphasizing only the most important diagnostic and surgical points, and refer the reader to such texts as Hertzler and the recent publication by Ward and Hendrick for more detailed study.

For this presentation I have drawn on an experience with a considerable number of patients observed over a period of more than three decades.

CLASSIFICATION OF TUMORS AND CYSTS OF THE NECK

I. Tumors of thyroid and parathyroid glands
   Thyroid: adenoma; carcinoma; sarcoma
   Parathyroid: adenoma; carcinoma
II. Tumors of salivary glands
   Mixed tumor
   Primary malignancy
   Cysts
III. Primary tumors of lymph glands
   Hodgkin's disease — Leukemia
   Lymphosarcoma — Endothelioma
   Lympho-epithelioma
IV. Secondary tumors of neck
   Metastasis from the buccal cavity
   Direct extension from the buccal cavity
   Metastasis from below the clavicle
V. Benign tumors
   Lipoma — Sebaceous cyst
   Myoma — Fibroma
   Dermoid — Adenoma
   Chondroma — Keloid
   Hemangioma — Cylindroma
   Lymphangioma — Xanthoma
   Atheromatous cyst
VI. Unusual tumors
   Mikulicz's disease — Neurofibroma
   Carotid body tumor — Ganglioneuroma
   Neuroblastoma — Boeck's sarcoid
VII. Cysts—fistula
   Thyroglossal
   Branchial: benign; malignant
   Hygroma
VIII. Inflammatory lesions
   Non-suppurative lymphadenitis
   Suppurative lymphadenitis
   Tubercular lymphadenitis
   Diffuse cellulitis (Ludwig's angina)
   Actinomycosis
   Blastomycosis
   Sporotrichosis

No classification ever has and probably ever will prove satisfactory to those interested in this subject and this one compiled from the work of others as well as myself is offered merely as a working hypothesis.

The large and debatable subject of *thyroid* tumors might be summarized as follows: Where preventive work has been carried on in certain areas for several decades, as it has in Switzerland, Ohio, Michigan and Wisconsin, the incidence of adenomatous goiter has been markedly decreased by the administration of iodine to the school children. It has been generally believed that malignant lesions of the thyroid develop in a pre-existing adenomatous goiter, and the incidence varies from as high as 20 per cent in the solitary adenoma of the male to 4 per cent in the multiple adenomatous group. A high percentage (31 per cent) in my own series of fifty-three cases was not suspected prior to operation. This group responds favorably to surgical treatment and irradiation in contrast to the diffuse adenocarcinoma group. The papillary adenocarcinoma type often seen in young persons is prone to metastasize locally to the adjacent lymph glands and generally offers a favorable prognosis. This class formerly was known as aberrant or lateral thyroid. The rare sarcoma is highly malignant. I have had

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1A 1B

FIG. 1. A, patient, aged sixty-five, with multiple toxic adenoma of the thyroid; basal metabolic rate, +59 per cent. Subtotal thyroidectomy was performed under nerve block anesthesia; B, same patient three months postoperatively; basal metabolic rate, +8 per cent; weight gain, 18 pounds

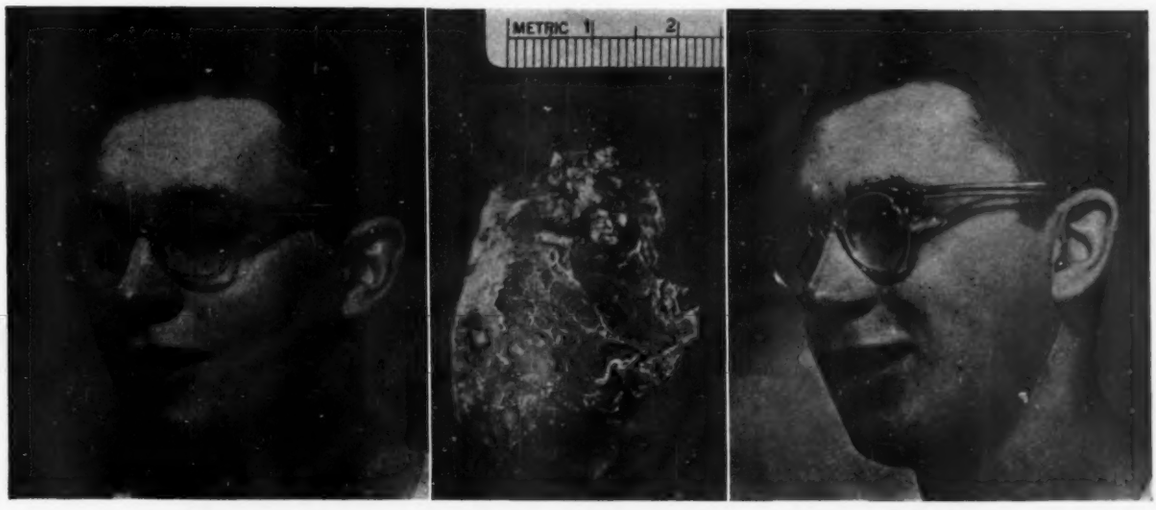
one patient with endothelioma who developed a recurrence twenty-four years after thyroidectomy and radium therapy. She is still alive after subsequent deep x-ray therapy. Radioactive iodine has not cured a patient with a malignant thyroid but it is helpful in some instances. (Fig. 1.)

Parathyroid tumors are relatively rare, may not be apparent locally even on surgical exploration, are evidenced by hypercalcemia and changes in the osseous structure and may be associated with renal calculi. Their removal may result in a spectacular alleviation of symptoms.

Salivary gland tumors may be cystic, benign, mixed or primarily malignant. The important point to remember about the commonest of these lesions, a mixed tumor of the parotid gland, is to remove it early while the capsule is intact. If this is done, a cure may be expected; otherwise it may be necessary to sacrifice one or more branches of the facial nerve. Sistrunk's operation has been the classical procedure in operating upon these tumors although some improvements in technic have recently been suggested by McNealy, Brown and others.

None of the *primary tumors of the lymph glands* respond successfully to treatment; nitrogen mustard gas and x-ray therapy merely delay the inevitable. There is no clear-cut differentiation between many of the tumors in this group, lymphoblastoma being a generalized term indicating that the tumor is due to a proliferation of the lymphoid tissue. While Hodgkin's disease is usually seen in younger persons and lymphosarcoma in older adults, there are many exceptions. In differentiating *Hodgkin's* from other glandular tumors of the neck one usually finds that this disease causes a discrete enlargement of one or more lymph glands usually situated in the posterior triangle of the neck. Subsequently glandular adenopathy may appear in the axilla and groin and an x-ray film may demonstrate mediastinal involvement. A dense fibrosis develops as the disease progresses. A positive diagnosis is determined only by performing a biopsy and finding the characteristic Sternberg-Reed cells. X-ray therapy is considered the best first line of defense; some patients respond remarkably well and live for years while others develop fever, secondary anemia and malaise and succumb in a few months.

In *lymphosarcoma* the disease tends to invade the capsule of the lymph glands and extend to surrounding tissues; the cells are uniform and fibrosis does not occur. Hodgkin's disease, on the other hand, tends to affect successive groups of glands in the manner of a constitutional disease. A sarcoma begins in a



2A 2B 2C

FIG. 2. A, because of its rapid growth, hardness and immobility, this mass was clinically considered to be possibly malignant; B, operation revealed an infected non-malignant branchial cyst that was removed intact under nerve block anesthesia; C, note location of the scar in the natural crease of the neck to avoid disfigurement.

single gland or closely related glands whereas in Hodgkin's disease one or more groups of glands is involved. A sarcoma grows rapidly, tends to bulge up beneath the upper portion of the sternocleidomastoid muscle, is apt to invade the skin so that it becomes reddened and even appears to fluctuate. Surgical removal may often prove to be a formidable procedure. In some cases in which such a diagnosis had previously been determined by others, I have been frankly surprised to find not a sarcoma but perhaps an infected branchial cyst. Although life expectancy is often a matter of only a year or two in sarcoma, an occasional patient treated early may be carried several years with surgery and x-ray. These tumors kill not so much by affecting the general health, as in Hodgkin's, but rather by attacking the important adjacent structures, the trachea, esophagus and large vessels. (Fig. 2.)

A *lympho-epithelioma* may appear first as an enlarged gland just beneath the angle of the jaw. Although it may arise from the nasopharynx, in many cases the primary source of the tumor may never be located. The diagnosis is confusing not only to the surgeon but to the pathologist as well, since both lymph and epithelial cells may co-exist and the tumor be indistinguishable from a sarcoma. This tumor is extremely painful and its appearance may proceed or follow the appearance of a pharyngeal tumor. It is firmer and more fixed than the sarcoma and tumor in Hodgkin's disease and often remains unilateral.

An *endothelioma* clinically resembles the tumors of this group but is far less malignant; patients suffering from this unusual lesion may live for many years after surgery and x-ray therapy. An extremely rare case was that of a large hemangio-endothelioma of the salivary gland which I removed from a four month old baby who recovered.

The story of *leukemia* is too well known to need reiteration here. Whether it is the acute fulminating type that so often strikes a child or young adult or the chronic form that more commonly attacks those in middle age, none survive. It is perhaps the most deadly of all glandular diseases. Fatigue, bleeding gums, an enlarged spleen, glandular adenopathy, fever, loss of weight, altered blood picture and bone marrow findings lead to the diagnosis. X-ray therapy and mustard gas prolong life but offer no cure.

A *secondary tumor* of the neck may give the first indication of disease elsewhere, as Virchow's node may indicate carcinoma of the stomach. Various lesions of the buccal cavity, such as carcinoma of the tongue, frequently manifest themselves by metastasis to the cervical lymph glands.

In the list of *benign tumors* of the neck the most frequently found and the simplest to remove is the lipoma. Soft and freely movable

3A 3B

FIG. 3. A, patient with rare Mikulicz's disease characterized by bilateral swelling of salivary glands, dryness of the tongue and mouth, and narrowing of the palpebral fissures; B, same patient successfully treated by surgical removal of the submaxillary glands. Another patient was cured with penicillin, which was not effective in this case.

its diagnosis is seldom puzzling, yet because of its location it may occasionally resemble a dermoid or a thyroglossal cyst.

Next in frequency is the common sebaceous cyst, equally easy to recognize and dispose of, although one should emphasize that it must be removed entirely to prevent recurrence. This is also true in the case of the harmless lipoma.

The myoma, dermoid, fibroma and remainder of this group are less common, seldom troublesome and chiefly of pathologic interest. In my experience the keloid is best treated by excision with the electrosurgical knife followed immediately with radium.

Of the unusual tumors of the neck I wish to mention briefly *Mikulicz's disease*, of which less than 100 cases have been reported, two of which were on my service. One case was that of a middle-aged man who was the first patient to be treated successfully with penicillin. The second patient, a young mother, required surgical removal plus penicillin to effect a cure. This disease is characterized by the absence of salivary flow, extreme parchment-like condition of the tongue, narrowing of the palpebral fissures and involvement of the salivary glands. (Fig. 3.)

The *carotid body tumor* is uncommon, less than 400 cases having been reported. Although this tumor may be malignant, its rate of growth is protracted so that patients may live for years. The tumor is so slow to invade the carotids that its early diagnosis may permit removal without too great a risk. The external carotid is involved first but, when the common carotid becomes invaded, ligation of this vessel in older persons is attended with a high mortality. This tumor may push the sternocleidomastoid muscle forward giving the appearance of a sarcoma, but at operation it is seen to arise from the carotid notch.

Still more unusual are a small group of tumors of nerve origin, the neuroblastoma, neurofibroma and ganglioneuroma, all of which clinically suggest Hodgkin's disease and are recognized only at operation. Boeck's sarcoid tumor of the neck may suggest Hodgkin's disease in an early stage. Usually skin manifestations and uveitis accompany a sarcoid lesion.

The *thyroglossal cyst*, the result of a congenital abnormality in the development of the thyroid gland, is situated in the midline of the neck, anywhere between the thyroid and the base of the tongue. It is the result of a persistent thyroglossal duct which may end at the hyoid bone or pass through, above or below it. When the duct extends to the base of the tongue, its surgical removal may be difficult,

and failure has not infrequently subjected many patients to repeated operation. A thyroglossal cyst may persist until middle age without causing symptoms; it may become infected and rupture spontaneously only to heal and later repeat the process. Sometimes it is lanced and then a discharging sinus may develop. Sistrunk's classical procedure still offers the best approach to the removal of these cysts. I have followed his technic in operating upon a series of twenty-eight patients, except that all operations have been done under nerve block anesthesia. I postpone operation in children until the fifteenth year preferably so that the child is able to cooperate better. The cyst is dissected to the hyoid bone, the center of which is resected; then if the cyst continues to the base of the tongue, its course is carefully followed and all tissue removed. The hyoid bone is usually resutured with fine chromic and the incision closed without drainage. If all the cyst is removed, recurrence will not develop.

The *branchiogenic cyst* results from a failure of the upper part of the gill clefts to become obliterated. It has a deep origin often arising from between the jugular vein and carotid artery and bulges into the neck as a smooth soft mass from beneath the sternocleidomastoid muscle. It may become infected and be mistaken for a sarcoma. In two instances in my series operation revealed a malignant change. The removal of the cyst involves careful dissection among the important structures of the neck and may be accomplished with nerve block anesthesia.

Thyroglossal and branchiogenic fistulous tracts may occur and may undergo malignant change. Finally, there remains the group of inflammatory lesions of the neck which is apart from the subject of this discussion.

In conclusion, it may be said that tumors and cysts of the neck form one of the most interesting diagnostic and surgical problems, one that in many instances offers insurmountable obstacles and yet frequently rewards the surgeon with unexpected and gratifying results.

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CONGENITAL POSTERIOR ANGULATION OF THE TIBIA

A CLINICAL ENTITY UNRELATED TO CONGENITAL PSEUDARTHROSIS

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HEYMAN and Herndon[3] in 1949 reported their experience with three cases of congenital posterior angulation of the tibia. These patients were all treated conservatively. The first one was treated with massage and manipulations; and when the infant began to walk, a brace was applied until three and a half years of age. The last x-ray at the age of seven showed the persistence of a mild degree of medial bowing of the leg bone. The child is reported at the age of eight to have ½ inch shortening. The authors' second patient was observed until the age of six. A brace was worn for three and a half years. The x-ray at the age of five and a half years disclosed mild medial bowing of both leg bones. There was 1 inch shortening. The third patient is still wearing a brace at the age of three years. At this age both components persist to a moderate degree; 1 inch of shortening is reported.

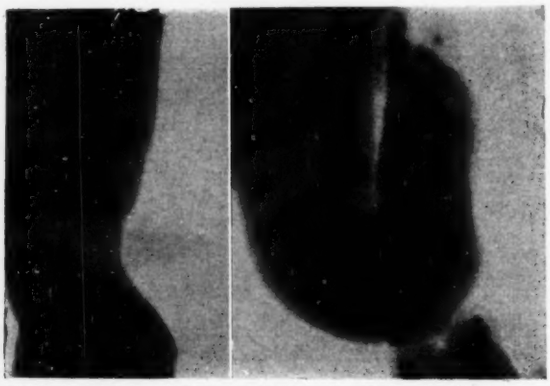


FIG. 1. Case 1. Congenital posterior angulation at birth.

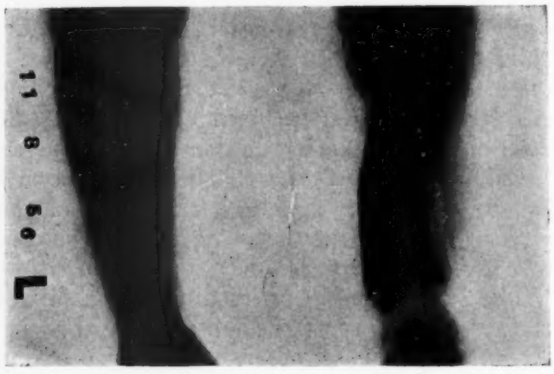


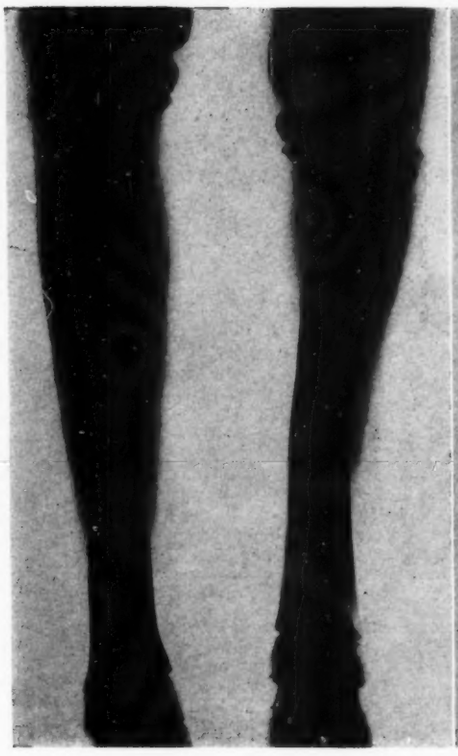
FIG. 2. Case 1. Preoperative appearance at twenty months after conservative treatment.

FIG. 3. Case 1. Ten weeks following wedge osteotomy of tibia.

These authors submit posterior angulation as a clinical entity, and rightly so, and describe the characteristics. It must be somewhat confusing, however, to the student of these rather rare anomalies to make this one a member of "Group III," Group I being congenital pseudarthrosis of the tibia and Group II an anterior angulation of the tibia which is a rather later and secondary complication of congenital absence of the fibula. This is confusing because in primary anterior angulation an attempt to correct this deformity by osteotomy invariably results in a failure of union. Indeed a "spontaneous fracture" usually occurs here without treatment and the prognosis is poor.

The anterior angulation secondary to congenital absence of the fibula is a resistant deformity (Group II of Heyman and Herndon) but, on the other hand, may be submitted to repeated osteotomy without danger of failure of union.

It is submitted in this paper that although a



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5

FIG. 4. Case 1. Age nine years, eight months; shortening of tibia estimated at 1¾ inches. Note persistence of medial bowing of fibula (fibula was not osteotomized). Upper tibial and fibular epiphysiodesis was performed two months later.

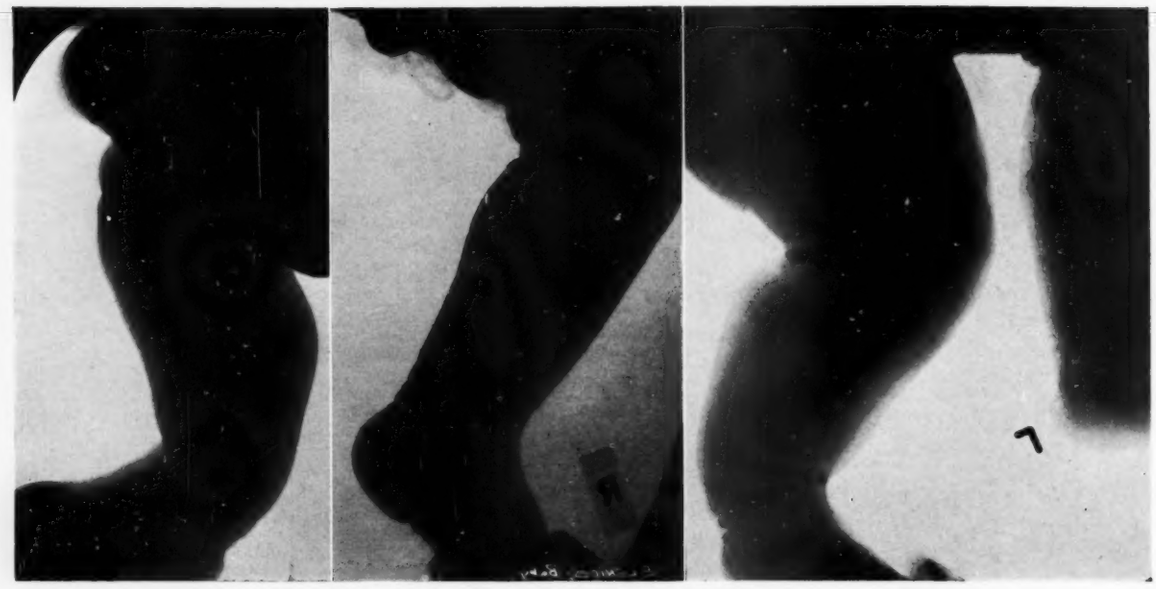
FIG 5. Case 1. Age twenty years; shortening 1 inch. Persistence of some medial bowing of fibula.

certain gradual and long-delayed reconstitution of the bony structure of the tibia and fibula in congenital posterior angulation may be expected to occur by "redressment," bracing and the passage of time, early operation may safely be performed at a very early age thus conserving time, money and a lengthy period of brace wearing.

It is urged herein that early operation in this condition is in total contrast to the possible advocacy of operation in the ordinary infantile and early childhood bowlegs and knock knees. In these latter conditions osteotomies are never or "hardly ever" indicated since they tend to spontaneous correction by growth processes up to the age of six or seven years.

The operation for congenital posterior angulation of the tibia and fibula should consist of a wedge osteotomy at the site of the deformity in the tibia and an oblique osteotomy of the fibula in its upper one-third thus simplifying postoperative fixation. By this means a perfect restitution of contour of these bones is restored

FIG. 6. Case 1. Slight discrepancy in size of feet at age of twenty years.



7A 7B 8

FIG. 7. Case II. X-ray appearance at birth; note obvious shortening already present.
FIG. 8. Case II. Deformity at age of eight weeks.

FIG. 9. Case II. Wedge osteotomy of tibia and oblique osteotomy of upper third of fibula at three months, four days of age; result forty-four days after operation.

within a few weeks. Shortening is inevitable by any means of treatment and this should be dealt with by epiphysiodesis of the upper tibial and fibular epiphyses when the patient is seven or eight years of age.

CASE REPORTS

CASE I. Congenital posterior angulation of the tibia was first observed in my practice in 1931. The patient was a male five weeks of age, the firstborn of Jewish parents. (Fig. 1.)

The unilateral calcaneus deformity had certain characteristics which distinguished it from the usual infantile condition which, of course, is usually bilateral. It also had the characteristic of being of extreme degree. Then there was the fortunate x-ray which had been made soon after birth. The x-ray displayed a nearly right-angled posterior angulation of the tibia and to a lesser extent the fibula just above the right ankle joint.

Treatment of the gross foot deformity was then undertaken by successive plaster of paris boots for a number of months, with indifferent success so far as the tibial deformity and calcaneus were concerned. (Fig. 2.) When the patient was twenty months of age, a wedge osteotomy was decided upon in full recognition of the fact that osteotomy in this region and at this age might be a questionable enterprise. The osteotomy healed promptly. (Figs. 3 and 4.)

At ten years of age the patient underwent an upper tibial and fibular epiphysiodesis. When last seen at the age of twenty he was conscious of no physical handicap. He had been a boy scout. One foot was a little smaller than

10 11

FIG. 10. Case II. Age seven years, five months; anteroposterior views.
FIG. 11. Case II. Age seven years, five months; lateral views.

the other; the extremity was 1 inch short. The circumference of his calf was 1½ inches short; he had a slight impairment of plantar flexion. The fibula, which was not osteotomized, presented a mild medial bowing. (Figs. 5 and 6.)

In 1931 I could find no description of this condition and supposed it to be new which apparently it was. It was discovered for me later[1] that the condition was known in France and several cases had been described. The outcome of these cases by "redressment" and conservative orthopedic measures was stated to be good except for shortening of the tibia and fibula.

CASE II. The second case turned up in 1944. The infant, a male, was of Greek parentage. The deformity was entirely similar. (Figs. 7 and 8.)

A wedge osteotomy of the tibia and in this case an oblique osteotomy of the fibula were performed at a higher level when the patient was three months, four days old. The osteotomies healed promptly with complete correction of the deformity. (Fig. 9.)

Examination at the age of seven years, five months showed a complete correction of the deformity, 1 inch of shortening and little or no lag in the growth of the foot. The calf circumference was ¾ inch less than the normal side. (Figs. 10 to 12.)

CASE III. I am permitted to report a third case, details of which were supplied to me in a personal communication by Dr. John C. McCauley, Jr.,[2] who incidentally was my associate during the earlier portion of the treatment of the first reported case.

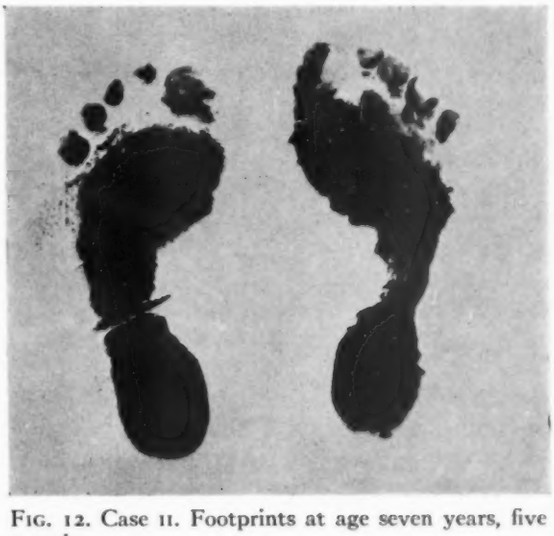


FIG. 12. Case II. Footprints at age seven years, five months.

This was a male infant first seen at the age of five weeks on September 2, 1948, with a right-sided deformity. He was treated con-

servatively until the age of six months when a wedge osteotomy of the tibia and an oblique osteotomy of the fibula were performed.

Examination disclosed that the deformity was corrected; at that time there was ¾ inch shortening. The right leg measured ¼ inch less in circumference than the left; the right foot was ¼ inch shorter than the left.

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SPIGELIAN HERNIA

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THIS spontaneous lateral hernia occurring in the linea semilunaris is little understood and infrequently recognized. It may assume an important consideration in the differential diagnosis of some abdominal tumors or, as revealed by a few reports in the literature, the cause of intestinal obstruction. For these reasons alone instances of this herniation encountered at rare intervals merit the inclusion in medical literature of the occasional case report. I wish to report a case in which careful and prolonged studies failed to reveal the true nature of a condition that simulated before operation an intra-abdominal mass in the left lower quadrant of the abdomen. In this instance the true diagnosis of spigelian hernia was not considered by us. It is our opinion that others, also, may not consider this hernia in similar situations.

CASE REPORT

The patient was a moderately obese seventy-two year old woman in good health, of short stature, who had accidentally discovered two months previously a rather large mass in the left lower quadrant of her abdomen. She noted some discomfort with rapidly progressive enlargement of this mass, especially during a recent prolonged coughing incident to acute bronchitis. She greatly feared a malignant process. (Fig. 1.)

Physical examination revealed a definite elongated mass about 14 cm. in length and 7 cm. in width lying in the left lower quadrant of the abdomen from the level of the iliac spine up to the umbilicus and lateral to the left rectus muscle. It was slightly movable, tender and somewhat doughy in consistency. My first impression was that of a tumor of the sigmoid mesentery or possibly a large interstitial lipoma. The physical examination otherwise revealed normal findings. All laboratory analyses were within normal limits. A proctoscopic examination to 15 cm. was negative and the stool contained no occult blood. A flat anteroposterior roentgen ray plate revealed only a medium-sized tumor in the right pelvis with characteristics usually ascribed to a calcified fibroid. The silhouette of a barium enema was normal and an intravenous pyelogram showed a normal urinary tract. In one instance the resident surgeon in the hospital thought he heard intestinal gas in the mass, and in his opinion it could be an unusual hernial sac containing bowel. However, several subsequent attempts to elicit these sounds were failures, so in consequence incarcerated hernial sac was dismissed in the differential diagnosis of this tumor. The provisional diagnosis resolved itself to that of a lipoma with possible sarcomatous changes existing either under the peritoneum or in the abdominal wall.

Under spinal and nitrous oxide anesthesia a low left rectus incision was made. The peritoneal cavity contained no free fluid. We discovered to our surprise that nearly the whole omentum had traversed a circular, 5 cm., rounded defect at the fold of Douglas in the semilunar line through the transveralis and internal oblique aponeuroses immediately at the border of the left rectus muscle. Further examination revealed no defects in the linea alba nor umbilical areas. There were no inguinal hernias and the canal of Nuck was identified and found separate and distinct. The intact external oblique aponeurosis covering the mass was then exposed. It was split in the direction of its fibers exposing a sac of peritoneum 14 cm. in length and 6 cm. in width. When opened it contained the omentum and the lateral border of the sigmoid without damage or any signs of having caused past or present intestinal obstruction. This large sac lay between the aponeuroses of the external and internal oblique muscles. Traction to the omentum emptied the sac and after severing some bands the sigmoid was freed. Repair was accomplished by removing the sac with closure and transfixion of the neck medially followed with imbrication of the fascial planes with interrupted cotton sutures. The calcified fibroid was removed and the ab-

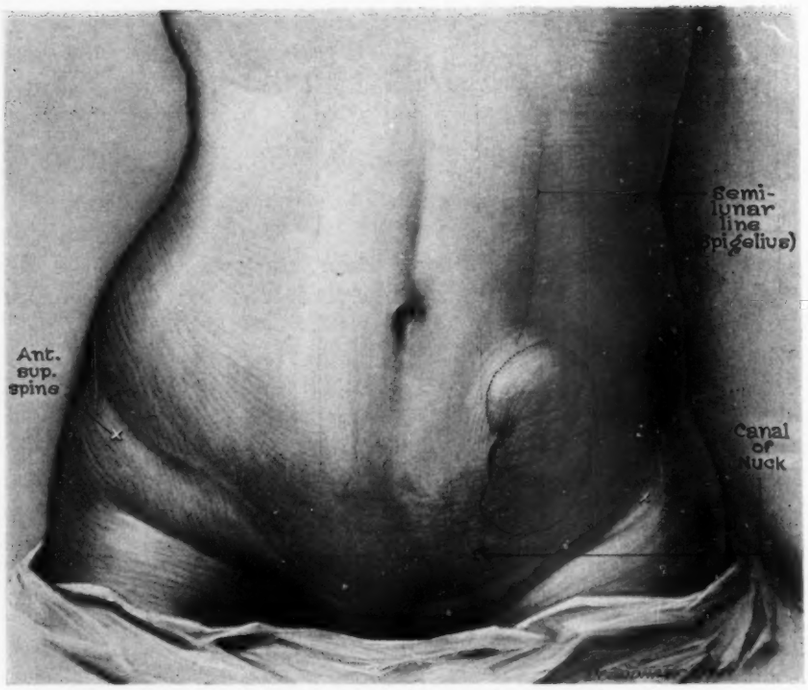

FIG. 1. Shows schematically position and relative size of tumor.

dominal incision closed. The patient made an uneventful recovery.

COMMENTS

As with any hernia, Mason and Ruge[1] in an excellent article report a case in which intestinal obstruction was present as a complication of this hernia. Cullen[2] and River[3] state that there are five to eight perforations measuring 3 to 4 mm. in length through which pass blood vessels and nerves that might tend to weaken the aponeurosis in this area and thereby tend to provide possible herniations. Cullen[2] states that these hernias occur in males and females with equal frequency. One might speculate that the female would be more afflicted because of intra-abdominal pressure during pregnancy. (Fig. 2.)

Zimmerman, Anson, Morgan and McVay[4] after extensive anatomic dissections illustrated that slit-like gaps between divergent bundles of fibers and properitoneal fat pads in the fascial layers of the internal oblique aponeurosis often occur in this area.

Surgeons are aware of the anatomic fascial pattern found in the repair of midline incisions. In upper abdominal midline incisions sufficient tense fascial layers exist both anterior and posterior to the rectus muscle for adequate closure. In low midline incisions the posterior layer of fascia is absent. This is due to the bizarre anatomic splitting of the aponeurosis of the internal oblique fascia. The anterior sheath of the internal oblique aponeurosis fuses with the aponeurosis of the external oblique to form the tense anterior sheath of the rectus abdominis muscle. In like manner the posterior layer fuses with the transversalis fascia to form the posterior layer. This fusion, both anteriorly and posteriorly, exists downward to a point usually midway between the umbilicus and the pubis. At this point, called the semilunar fold of Douglas, all the layers fuse to pass anteriorly to form an anterior sheath only. (Fig. 3.)

The cases reported in medical literature describe much smaller hernias than herein reported and with frequent bowel strangulation since the sac usually contains subperitoneal fat omentum and small bowel. There can be many variations of these hernias, and Berger[5] has reported an instance in which such a hernia was present on the right side with one on the left simultaneously.

The literature provides no clear-cut symptom complex for such a hernia. It may be a simple mass of incarcerated omentum giving rise to a tumor with minimal symptoms such as the one I have described. Usually, however, partial or complete bowel strangulation occurs requiring

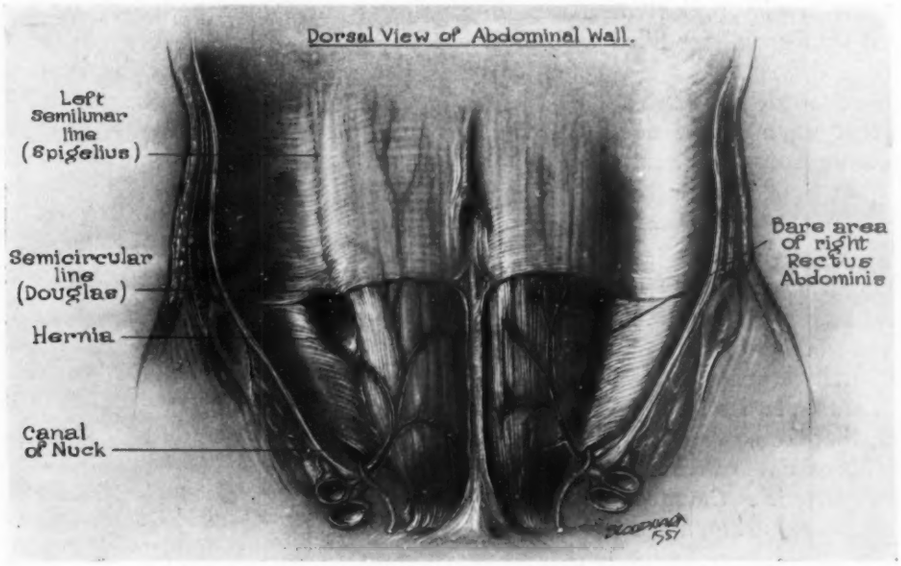

FIG. 2. Ventral view to illustrate site of hernial opening.

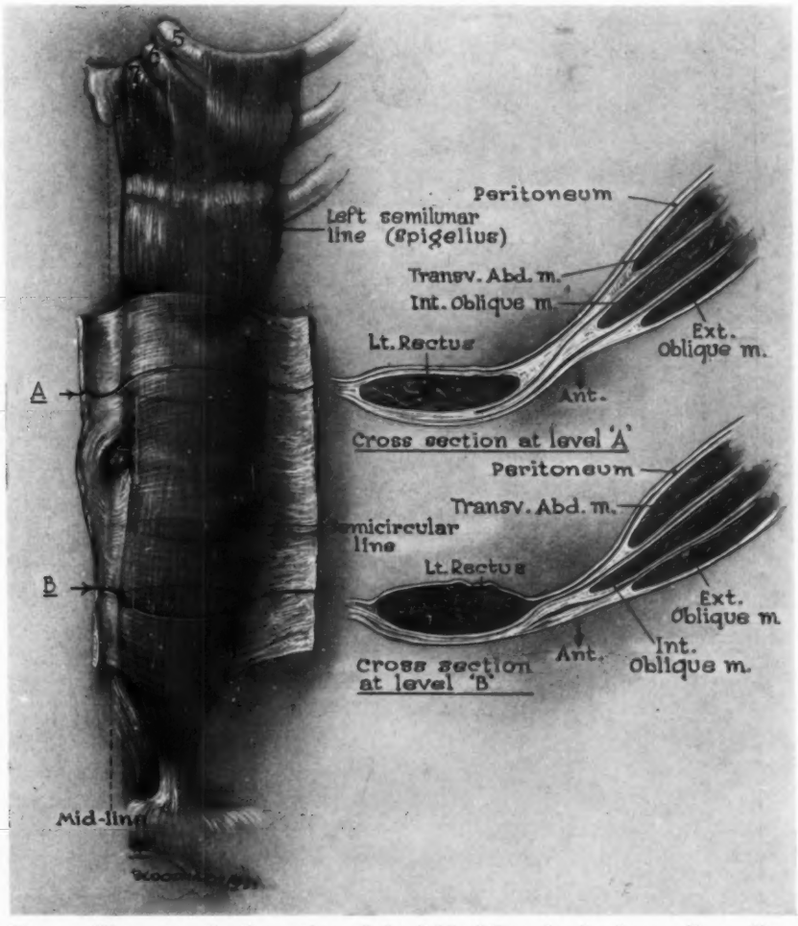

FIG. 3. Illustrates the formation of the fold of Douglas in the semilunar line. Above this line the split internal oblique fascia fuses both anteriorly and posteriorly to the rectus muscle. Below this point all the fascia becomes anterior.

immediate and heroic surgical measures. For this reason if the hernial sac filled with omentum only as here described is suspected, early correction is important since intestinal obstruction may occur at any time due to intra-abdominal pressure from any cause.

SUMMARY

An instance of a lateral ventral hernia, often called semilunaris (spigelian) hernia, is reported. It is emphasized that it may be a very dangerous type of hernia, rarely reported but probably occurring with much frequency. We find that this hernia is not understood universally and, therefore, is rarely suspected and diagnosed. This case represents the largest such hernial sac reported. Although an important consideration it was not included as a possibility in our preoperative differential diagnosis. Had an intestinal obstruction existed in addition to the tumor, perhaps a suspected correct diagnosis would have been made. It is hoped by the author that this case report will assist others to keep in mind the possible existence of such a hernia and stimulate the reporting of instances of a like condition.

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THE LOST ART OF CLINICAL DIAGNOSIS

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WHEN asked to speak to a hospital staff on the lost art of clinical diagnosis my first impulse was to shy away from a subject which might place me in a group of antiques which could not be restored. But on further reflection I concluded that I would risk any criticism and try to do something with a subject which always has been of interest to me.

Let me begin by saying that we could not practice the medicine of today without the aid of the laboratory any more than we could get along without nurses and other auxiliary services common to all hospitals. There are many diseases which can be recognized only with laboratory assistance and the treatment can be carried out only by continued minute observation. Where would we be without the laboratory in such diseases as diabetes or the various blood dyscrasias? Certainly, the diagnosis of early tuberculosis would not be possible without the x-ray. In my early days we depended on physical signs only; and while some men became very expert in inspection, auscultation and percussion, I am sure that many early and curable cases were missed. My own inadequacy in hearing finer sounds with a stethoscope is partly responsible for my taking up surgery as a specialty.

My contention is not going to be to discard any part of the laboratory; on the other hand, I am not willing to discard the clinical examination and make the laboratory the superclinician to guide us in all of our conclusions. I cannot subscribe to the treatment of sick people only from a chart.

My associate, Dr. Samuel Simkin, recently called my attention to an account of one of the pathologic conferences so ably conducted at Massachusetts General Hospital. The discussion centered around a patient who presented a large abdominal mass which proved on exploration to be a retroperitoneal fibrosarcoma of low grade malignancy. After the case history was presented, the discussion was opened by the attending surgeon saying, "We might consider the laboratory findings first." Of course, none was helpful except in a negative way. I can say only that this approach was not in keeping with that of the master clinicians of my time. This tumor might have been one of many things, even an aneurysm. At least some tentative suggestion might have been made. It might be argued that an attempt was made at diagnosis by exclusion. This latter can be a helpful procedure but in my opinion should be used only after more direct methods have been considered. A review of possibilities is an orderly and sometimes automatic way of thinking which may be used unconsciously.

In November, 1948, the Surgical Association of Louisiana was organized. I was honored by being asked to deliver the opening address and chose for my subject dissertation along the same lines as the one I am using today. Strange as it may seem, several confrères wrote notes of commendation saying that we were leaning too far to mechanically made diagnosis and by so doing did not see the patient as a whole being. In this paper I made a plea for closer cooperation between medical men and surgeons and I should add to this pathologists and other laboratory services. There are many diseases, such as gallbladder disturbances, stomach disorders and thyroid anomalies, which while not always curable may be benefited by surgery. They should be studied with the patient in mind and not the chart, with its numerous attached laboratory sheets. In other words, treat the patient by what he shows and not simply by looking at his record.

On an October 4th television program Groucho Marx interviewed an intern from a Southern California hospital:

Groucho: If I were found unconscious on the sidewalk, what would you do?
Intern: I would work up the patient.
Groucho: How would you start?
Intern: Well, I would do the laboratory work first. I would do a red count and hemoglobin and then a total white and differential count.

With this, the quizzer changed the subject.

The intern did not mention examination of pulse, pupils or limbs for flaccid paralysis; color and general appearance of the patient were never considered. The simple fact that no one ever dies pink but always white or blue might have been suggestive.

I have before me two papers by distinguished English medical men and I am impressed by their titles alone. One title is "Clinical Sense and Clinical Science," by Dr. John A. Ryle, Regius Professor of Physic in the University of Cambridge. While this learned address was delivered in 1939, it could be read with profit today. Ryle stresses the estimate of the whole patient and his reactions to his illness which may tell more than all the details of a modern complete investigation. A good memory and the association of ideas may save much time and expense.

Ryle recounts one story about Sir William Gull who was the great medical consultant of his day. While on ward rounds a group of surgeons were examining a patient with an ununited fracture who was giving them some concern. Gull, a medical man, was waylaid and asked for his advice. He took a good look at the man and said, "Feed him on tomatoes." Nothing more was said. Needless to say the fracture united in a reasonable time; and when Gull was questioned, his answer was that the surgeons knew all about fractures but had failed to observe that the man had visible signs of scurvy. This was not just a shot in the dark or pure guesswork. It was the result of keen powers of observation and an orderly process of pulling out mental jewels stored away for just such contingencies. We frequently saw such habits in some clinicians when information was stored in special mental pigeonholes to be brought out when needed whereas the biologist, chemist and physiologist must have records and orderly protocols for reference under given conditions.

Good clinical sense seems rarer today than when the use of our own special senses was the only help we had. I am a product of the time when, aside from the usual methods of palpation, percussion and auscultation had to be relied on. I can remember all too well the time when yellow fever and some other diseases were recognized by odor with great accuracy. It was Faget who called attention to the slowing pulse rate in spite of the elevated temperature in the later stages of that disease.

Of course, quick observations may be fallacious. DaCosta once said that an "intuitive diagnosis was a rapid method of arriving at a wrong conclusion." Sir Frederick Gowland Hopkins in an address to the Royal Society in 1934 said, "The older physicians, with minds undisturbed by a crowd of scientific facts, developed a clinical sense—*sui generis*—as subtle as the sense of taste or the sense of smell, and it was on this sense that the great school of English medicine was founded."

I certainly do not want to convey the idea that the laboratory is not essential in the care of the sick man; perhaps it is a feeling that I do not care to give up the art of medicine for the science. Each has its place and each should be used. There is a well known story (now often repeated) that was told to me by the late, great Harvey Cushing. The chief of the medical service in a certain hospital was away and the staff was in charge of the service. A former student, now a country doctor, happened in one morning on a visit. The ward rounds were about to begin and the country doctor was invited. He was shown a patient with a continued fever and it was explained that many studies, such as blood counts, blood chemistries, blood cultures and x-ray pictures, all had been done. Still there was no explanation for the fever. The country doctor listened attentively to all reports. He turned down the sheet, palpated an enlarged spleen, noted the pointed tongue and rose spots on the abdomen. He then turned to the group and remarked, "I did not know there was any typhoid fever in this part of the country!" Imagine the consternation! Of course, these inconclusive studies were done at considerable expense. We should keep such examples in mind when we are faced with the high cost of medical care.

I quote from the August, 1950, Journal of the American Medical Association: "There is reason to hope that more logical planning of laboratory research and more critical appraisal of clinical observations will result in economies of time and material and hasten the coming of important medical discoveries."

Within the last few days a friend, who is a hospital administrator, told me of seeing a group of interns and residents going over a chart and many reports. Finally, one of the group said, "Let's have a look at the patient. We might get some information there." With a group who started at the wrong end this is

doubtful. The late A. J. Ochsner must have had this theme in mind when he spoke at the meeting of the Surgical Section of the American Medical Association some years ago when I was secretary of that body. The subject under discussion was the significance of the blood count in the diagnosis of appendicitis. Doctor Ochsner said that he usually ordered a blood count, operated and then looked at the count. This facetious remark started a miniature hurricane. Just one more illustration is a story related to me by Doctor Matas whose familiarity with the French School is well known. It is said that Laennec was walking under a balcony one day when a patient expectorated on his hat. Those accompanying the "father of auscultation" wanted to remonstrate with the patient. Noting the nummular character of the sputum, Laennec said to let the poor fellow alone as he would be dead very soon anyway.

I have often wondered if it would be a sound idea to emulate some of the teachings of Joseph Bell of Edinburgh. You will recall that he was the inspiration for Conan Doyle's supersleuth, Sherlock Holmes. Doyle was one of Bell's students and from his astute deductions gave us the first and greatest character of detective fiction. A classmate of Doyle's, the late W. W. Chipman of Montreal, told me that Bell's quick observations were uncanny. By a man's walk he would conclude that he had been a sailor, a soldier or a civilian. Anemia, cachexia, arthritis and tuberculosis would be recognized often by appearance alone.

The ability to observe, to remember and to compare is often responsible for decisions which cannot be explained. How many times have we said to ourselves, "This patient reminds me of a man I saw once, who turned out to have such and such a condition." This sort of experience is the outgrowth of a retentive memory and a knowledge of the pathologic possibilities. Sometimes it is embarrassing to try to explain just how one arrived at a tentative diagnosis. Often, a few well directed questions will put one on the right track and then our training and use of disciplined special senses can be of great help.

In an address delivered at Guy's Hospital in 1939 by Frank Cook, an examiner in gynecology, some very pertinent reflections were recorded which I like to think of as being worth while. Cook records one instance when he was called to see a dying old lady to treat her for a vaginal discharge. The fact that the patient was near death had escaped the notice of her physician. This astute observer thinks that 80 per cent of the work performed by the clinical laboratories and the x-ray departments is more or less unnecessary although conducted under the noble guise of teamwork. How often do we see neurasthenic females shunted from one specialist to another and in the summing up we see recorded a test meal, x-ray examination, a cystoscopy, rectal examination, a sigmoidoscopy and a vaginal examination with a speculum. This patient may end up with the removal of her appendix and a continuation of her distress. All of this, when a more adequate income or change of surroundings might be what is required. During the last war I saw many women with all sorts of complaints. These people were keenly disappointed when no definite diagnosis could be made. On occasions the fact that they were concerned about a son or near relative in the Pacific was the real distress and they were searching for some physical ailment behind which to hide. When such people are referred to us, our ability has been challenged and our professional conscience makes us try to be as thorough as possible, often at great expense to the patient.

It would be wrong for me to convey the impression that I am a nihilist in any sense of the word. My purpose is to see the patient as a whole and not as something to be boiled in a test tube or to be sliced under a microtome for examination under the microscope. This is a plea for the judicious use of the laboratory as a necessary part of our armamentarium. We know only too well that certain diseases can be recognized only by laboratory tests. What would we do without a competent radiologist? These services, however, may not be always at hand! The most famous man in medicine in the past generation was William Osler and one of his early contributions was on the use of the microscope; in fact, Osler was a finished pathologist. However, those who knew Osler well say that he was not a good lecturer. His desire was to be a good clinical physician. He is quoted as saying that "medicine is learned at the bedside, and not in the classroom." Learn to use your special senses and see what you look at. To use one's senses of feeling and smell one must think, reason and use one's head.

As long ago as 1924 I saw the trend and asked for some reforms and I made this my chair-

man's address before the Surgical Section of the American Medical Association. The scarcity of rural physicians was apparent even then, as practice was becoming increasingly difficult without much expensive equipment,—far beyond the reach of the average physician. As a consequence many rural practitioners followed their vanishing practices to medical centers. Are we not laying too much stress on the foundation that is the basic sciences and neglecting the superstructure? It seems to me the ideal would be a proper combination of clinical teaching with laboratory investigation. I dislike to think that the future of medicine is in the hands of the biologist, biochemist and pathologist. Again I say the present day teaching is at least partially responsible for the high cost of medical care and may help to drive us into socialized medicine.

We may well ask ourselves the reason for the present trend. There is no single explanation but our own teaching methods are partially responsible. Again to quote Doctor Ryle, "Medical education, while multiplying diagnostic aids and instilling far more basic science than our fathers had, is failing in the cultivation of judgment and the faculty of perception from which judgment derives."

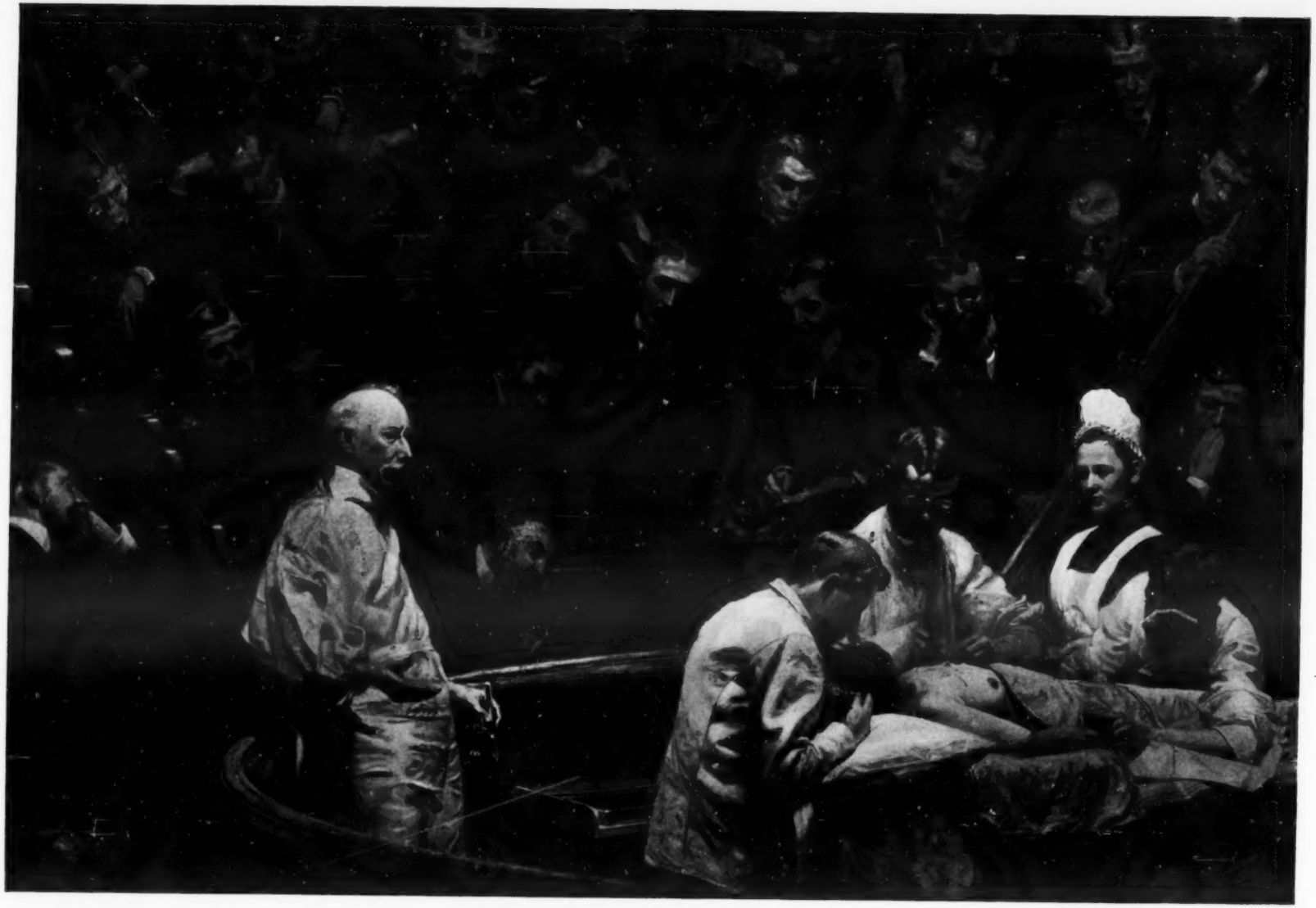
The division of medicine into specialties has played a part in that it breaks the continuity of teaching. The general approach to any problem would seem the more practical way. "Investigation is tending to supercede and exclude instead of supplementing clinical appraisement."

Again, for fear of creating a wrong impression I would like to emphasize that I do not in any way minimize the value of laboratory procedures. My plea is for their judicious use and for the correlation of the information with the clinical appraisal of the sick person. Some changes may have to be made in the medical curriculum. The student should see an occasional sick man early in his career so he will know the application of his preclinical studies to his clinical years. There is a gap between the preclinical and clinical years which must be bridged. I am happy to say that a beginning has been made in the Medical School of Louisiana State University. Your confrère and mine, Doctor Essrig, was largely responsible for inauguration of a course in surgical anatomy.

In a recent address delivered before the Society of University Surgeons, S. W. Moore of New York gave a brief outline of the beginnings of "Surgery As a Specialty and the Present Day Resident Training and Specialization in Surgery." This address gives much food for thought and makes one wonder if the specialization does not begin too early and go too far. Does the intern and then the resident plan his course too soon because he fixes his sights on becoming certified by one of the nineteen specialty boards? As noted by Moore some men are taken immediately from medical school for training in gynecology and obstetrics. When certified by their respective boards they consider themselves capable abdominal surgeons. The boards do excellent jobs and their certificates have merit, but should the supervision stop there? I heard recently of a man who treated all of his fractures with open reduction. When asked if this was the method he always used he said it was, for it was the only way he had been taught. I wonder what board certified this man!

We might ask ourselves, is it best for men to go directly into some specialty? Such training may succeed in medical centers but will certainly make for a scarcity of rural practitioners and does crowd the profession with young, capable men who have hard struggles ahead. The time is not too far behind us to remember when the young doctor began with a general practice and drifted into his specialty; in the meantime he acquired the over-all picture of the sick person. Some of our greatest contributors during the last generation started this way.

For fear that I may be thought to be too much of an iconoclast, I would like to dispel this notion. Again let me make the plea for correlation of clinical sense and clinical science! Neither one should be used to the exclusion of the other; and while clinical sense will often have to serve us, let us make the best of it and use all the science needed for the diagnosis and treatment of the sick individual. Anatomy and pathology are more static than some other branches. Giant strides have been and will continue to be made in physiology, bacteriology and biochemistry. We must keep abreast and use these sciences with proper discrimination. In this way we may help to minimize the cost of medical care and restore to an ancient and honorable profession the art of clinical diagnosis.



THE AGNEW CLINIC—1889
Courtesy of the University of Pennsylvania

by Thomas Eakins (1844–1916)

SURGICAL OPERATIONS FIFTY YEARS AGO

RUDOLPH MATAS, M.D.
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[Dr. Rudolph Matas in his ninety-first year is engaged in writing an ambitious history of medicine in Louisiana. It is designed to run into several volumes and Dr. Matas says he will not live to see its finish. We hope he will be disappointed. Rather than put added burdens on his shoulders we are reprinting his "Surgical Operations Fifty Years Ago" which we published in the Fiftieth Anniversary issue in 1941. This essay by the outstanding surgical pioneer in America has been considered a rare literary gem. Ed.]

IN accepting the invitation to contribute my personal experience on "Surgical Operations Performed Fifty Years Ago" for the semicentennial number of the American Journal of Surgery, it occurred to me that the most effective introduction to the subject would be to reproduce the image of a representative American surgeon operating in a surgical clinic typical of the American scene fifty years ago, just about the time when the Listerian revolution was beginning to assert itself in this country.

The *Journal* has been most happy in selecting as a fitting frontispiece* to its semicentennial issue an artistic reproduction of the now famous painting by Thomas Eakins (1844 to 1916) which so faithfully and admirably depicts the fine, intellectual and kindly personality of Dr. D. Hayes Agnew, one of the ablest and most honored master surgeons of the past generation, who is seen holding one of his celebrated clinics at the Pennsylvania Hospital in Philadelphia, in 1889.†

To those of us who have lived and participated in the surgical life of the pre-Listerian period, this portrait of Agnew and his clinic has a special appeal as it reproduces with absolute fidelity the dawn of the new surgery as it was beginning to appear above the horizon in every one of the leading hospitals and surgical centers of America and throughout the world.

RECOLLECTIONS OF A PRE-LISTERIAN INTERNSHIP

Since I am expected to give some account of personal impressions and experiences, I trust I may be excused for speaking in the first person, as I might as well begin with the earliest recollections of my medical career which began as a matriculate of the Medical School of the University of Louisiana (now Tulane), in the fall of 1877, and as an intern of the Charity Hospital of New Orleans from 1878 to 1880, when I was graduated as an M.D.

Thanks to the opportunities given me by my internship, I had ample occasion to acquaint myself with the operations and methods of wound treatment which were in vogue at the hospital at a time when Pasteur's discoveries and Lister's application of them to surgery

* This portrait is now at the Wistar and Horner Museum of the University of Pennsylvania. It was presented at the annual commencement of the Medical School at the University, on May 1, 1889, by the undergraduate classes in honor of Professor Agnew on the eve of his retirement from active teaching. Dr. Agnew is shown leaning on the low railing of the amphitheatre in an easy posture, having just completed an excision of the breast for cancer, still holding the scalpel in his left hand (he was ambidextrous). All the figures were taken from life, including that of his successor, J. Wm. White, his first assistant. The painting is justly regarded as one of the masterpieces of Thomas Eakins, that famous artist who made a specialty of medical subjects.

In the treatment of his subject, the painting is an amplification of the portrait of Dr. Samuel D. Gross, done by the same artist. The picture incidentally shows an interesting change in surgery, the white garments of Dr. Agnew and his assistants being an innovation, due to antiseptic surgery, unknown in Gross' time.

The following is the inscription on the frame: "D. Hayes Agnew, M.D., chirurgus expertissimus; scriptor et doctor clarissimus; vir veneratus et carissimus," which, being translated, reads: "The most experienced surgeon, the clearest writer and teacher, the man most beloved and venerated." (J. Howe Adams. "Life of Agnew," p. 333. Philadelphia, 1892. Davis & Co.)

† This picture appeared in color in the January, 1941, issue.

were still in doubt and dispute, despite the fact that Lister had enunciated the principles of the antiseptic doctrine in 1867, and had continued to accumulate evidence in its favor during the ten intervening years (1867 to 1877).

Let us remember that in 1878 to 1880 the belief in spontaneous generation was not yet dead. Many people in the world still held it with all the ancient Aristotelian credulity, and many listened with sympathy to the prejudiced and specious arguments of Pouchet and Colin at the French Academy, of Bastian in England, and Liebig in Germany, long after Pasteur had delivered the deathblow to this belief, a whole decade before, when he irrefutably demonstrated its fallacy and failure as a scientific explanation of fermentation and putrefaction. And so it was that in medicine and surgery very slow progress was made in learning how to use the words "infection" and "sepsis" in a Pasteurian and Listerian sense, that is, as synonymous with bacterial invasion, a living contagion, a transmissible, inoculable and multipliable entity amenable to all the laws that govern animate things—the *contagium vivum et animatum*—the microbe.

This does not mean that the words "infection" and "sepsis" in relation to wounds were new or unknown before the antiseptic age. The word "sepsis" had been in use since the beginning of the eighteenth century, and "antiseptic" substances had been recognized from time immemorial to designate chemical agents that were opposed to putrefaction. The pharmacopeia was indeed rich in these substances long before Lister, who basing himself on the researches of Lemaire and Calvert, had brought carbolic acid into prominence as the chief representative of the antiseptic group.

Thus it was that during the course of my internship at the Charity Hospital we, of the staff, were quite familiar with the corrective properties of chlorinated soda, better known as Labarraque's solution, and other chlorine derivatives which played so conspicuous a part in the Carrel and Dakin treatment of wound infections during the first World War. Iodine in alcoholic or aqueous solution, potassium permanganate, the coaltar solution popularly known as Goudron Bobeuf, zinc chloride, Peruvian balsam, Friar's balsam (tincture of benzoin compound), alcohol, spirits of camphor, glycerin, tincture of arnica, nitrate of silver, turpentine, calomel powder, yellow bichloride wash, black calomel wash, iodoform, and innumerable other aromatic alcoholic tinctures including aromatic wine, "vin aromatique" of the French Codex, played an important rôle in the "mundification" (disinfection) and deodorization of wounds and infected areas, long before their value as germicides entered into the calculations of their prescribers. Nor were the ubiquitous hot flaxseed poultices forgotten as the ever faithful arm of our fathers in days of purulent trouble. But carbolic acid held the spotlight in the antiseptic scenario until the early nineties, when it was temporarily dethroned by the introduction of the bichloride of mercury (corrosive sublimate). This had been shown in the laboratories of Robert Koch, in Berlin, to be infinitely more germicidal by the tests of the laboratory. However, after causing very considerable mischief the corrosive sublimate failed to hold its supremacy in the clinic by the loss of bactericidal efficiency in the presence of coagulable serum and in the purulent secretions of the wounds, despite the efforts of Dr. E. Laplace, of our staff, and a pupil of Koch, in New Orleans, to maintain its laboratory efficiency by the addition of tartaric acid to the sublimate solutions. Fortunately for the hands of the surgeons, the personnel of the operating room and the skin and tissues of the patients, the need of this most irritating, toxic and discoloring agent ceased with the advent of heat sterilization and the rubber gloves or "boiled hand."

In the transition between the old septic and the new antiseptic period there were many modes of treating wounds, almost as many as there were senior surgeons on the staff. These variations were most notable in the treatment of compound fractures, lacerated and incised wounds and especially amputations, which were the most frequent major performances at a time when the field of surgery was much restricted in its indications and limitations (1877 to 1880).

Notwithstanding the seeming indifference or reluctance to adopt the typical Listerian dressing, there were certain prominent features of the antiseptic ritual which found general acceptance, even when the doctrine itself was subject to doubt and criticism. These were:

(1) The use of carbolic acid as the preferred antiseptic.

(2) The revival of drainage with Chassaignac's rubber tube in wounds and in closed

amputations, leaving the stumps open and unclosed.

(3) The gradual adoption of the buried, short cut, carbolated ligatures, preferably Lister's catgut or silk. But even this marvelous improvement in technic was slow in coming, for, in 1878 and 1879, I saw a number of amputation stumps from which long ligatures dangled, waiting to ripen in pus to drop off.

(4) At an amputation it was the most frequent practice to irrigate the wound with a 5 per cent carbolic solution, then insert the rubber drains and suture the flaps, leaving large intervals between the sutures, after which adhesive strips were applied to support the whole stump, while compressing with gentle pressure to avoid dead spaces.

(5) The stump and limb were wrapped in cotton batting (later sterilized absorbent cotton was used) and bandaged with the wide heavy cotton or linen rollers of that period.

While this mode of treatment gradually became part of the routine management, the procedure was something of a compromise with the early Listerian ritual in which many of the minor features were missing. It was virtually the same dressing which Lister himself had modified from Syme, his father-in-law, in Edinburgh, long before Lister had arrived at the conclusion that infection was the assault of a bacterial invasion.

As relics of the pre-antiseptic period, various methods of dressing and treating stumps were still in evidence before 1880. These varied considerably, according to the school in which the surgeons had been trained. The surgeons who were graduates of American schools were largely inspired by the American texts of Ashurst, Gross, Hamilton and Agnew, with a fundamental leaning toward British traditions (Astley Cooper, Erichsen, Bell, Paget, etc.). Those of French origin still held allegiance to the great Parisian masters, Dupuytren, Velpeau, Lisfranc, Broca, Nelaton; while the few Germans swore by Von Graefe, Langenbeck, Volkmann and Billroth.

As a result of this international medley, a number of methods were devised to protect the amputations from infection or to combat it when it occurred. These procedures if catalogued would embrace over twenty to twenty-five designated titles, and can be generally classed under two heads:

A. Methods which aimed at a free contact of the open stump with the air, with or without approximation of the flaps, kept wet or dry according to the circumstances. The open or dry methods were advocated in Britain by Teale, of Leeds, Humphrey, of Oxford, Stimpson, of Edinburgh (1860), and with some modifications by Volkmann, Thiersch, Nussbaum and Billroth (1855 to 1876) before their conversion to Listerism.

(1) A typical dressing of the *open dry type* was that practised systematically by Dr. James R. Wood, of New York, which is graphically described by Dr. Frederick Denis, his devoted intern (1876):

"After the limb has been amputated, the flaps are not even coaptated, but left entirely open. A pillow of oakum is placed under the stump, which is allowed to rest upon this support until the wound is nearly healed. A small piece of gauze is placed over the contour of the stump and a cradle over the limb, so as to avoid contact with the clothing. This is all the dressing that is employed; no sutures are used except in lateral skin flap methods, no adhesive plaster, no oil silk, no bandage. No dry charpie is stuffed into the wound, no fenestrated compresses are placed between the flaps; in other words, the stump is left entirely alone, naked, just as the surgeon made it in his amputation. . . . As the wound drains freely, it is irrigated at frequent intervals with carbolic solution, after which Balsam of Peru (which makes a fine stimulating application) is poured over the granulating surface. When suppuration has subsided the flaps are gradually approximated by strips of adhesive plaster."

(2) In the *wet division* of the open methods, the most prominent was the "cold water dressing" of Robert Liston, used in bad septic cases as late as 1885 and later. This consisted in holding the stump on a rubber covered pillow, keeping it constantly wet by a drip of cold water, (plain or medicated) falling on a thin gauze cloth from an overhanging receptacle, the water draining by a gutter to a bucket on the floor.

(3) In this group also was the "*simple open wet dressing*" *of Prof. John Asburst*, of Philadelphia (1870 to 1885), in which the sutured stump was drained with rubber tubing and kept wet by loose surface dressings *soaked in laudanum*, substituting this by alcohol at the end of forty-eight hours.

(4) An extension of the *open wet method* was

that advocated by Langenbeck, in Germany, Lefort and Verneuil, in France, and Hamilton, in New York, which consisted in keeping the patient himself immersed, with his open undressed stump, in a tub with flowing plain or medicated water. This was carried out on the same principle as the Hebra continued tub baths utilized to this day in the Austrian and German dermatological clinics.

B. Methods which aimed at the total *exclusion of air* from the stump, under the impression or belief that the infection, whatever it was, was transmitted through the air,* in manifest contradiction to the principles held by advocates of Class A.

(1) Perhaps the most typical of these was the method to be described later, the "*pansement ouaté*" of Alphonse Guerin, with which I was most familiar, as I had seen it applied at the Charity Hospital.

(2) Other methods which were remarkable because of the devices used to exclude air from the stump were: the "pneumatic occlusion" of Jules Guerin (1865); the "incubation method" of Jules Guyot; the "pneumatic aspiration" method of Maisonneuve, which aimed at the constant aspiration of air and secretions; the dry closed covered dressing, with drainage, practised by Syme and Lister before Pasteur's discoveries (1850 to 1860).

(3) Among others were the "Bordeaux method," a compromise between the Guerin and Lister methods (1864); the "earth pack" dressing of Addinell Hewson, of Philadelphia (1872); the coagulating "perchloride of iron dressing" of the open stump of Bourgade, of Clermont Ferrand, France, which created with the perchloride a "tough leathery cuirass of necrotic tissue which completely isolated the subjacent tissues from the influence of the contaminating air and other surrounding agents. This mass was detached slowly after the sixth or tenth day, and in becoming detached, left a surface covered with healthy granulations. The wound was then dressed with aromatic wine and the flaps brought together to induce union by second intention."

This multitude of dressings and their variants, of which the titles just referred to are only samples, and in which the advocate of each mode deplored the great mortality of amputations in the hands of other surgeons and confidently put forward his own method as superior, which, by his own experience, he had proved best—showed by the complexity of methods and their contradictory principles and ideas—how, in ignorance of the essential causative factor of infection, the surgeons of the preantiseptic period, in despair at the fearful and prohibitive mortality of their operations, sought frantically anywhere and everywhere, for some mode of relief.

ALPHONSE GUERIN AND THE "PANSEMENT OUATÉ"

Of these international and pre-Listerian methods, I was most impressed by the closed method of treating amputation stumps, which had been introduced by Dr. Yves Lemonnier, a distinguished Louisianian of French descent, who, on returning from Paris in the early seventies had brought with him, and applied for the first time, the closed, cotton-pack dressing of amputation stumps known in France as the "*pansement ouaté*" of Alphonse Guerin and which we, the interns, designated as "Lemonnier's cotton bale dressing." Though Guerin and his "*pansement ouaté*" have long since been forgotten, even by the few men who have survived the period of our internship, I feel justified in lingering over it as an episode of particular significance as a precursor of Listerian practice, as well as on my own account because of my vivid recollections of the genial surgeon who sponsored it and of the benefits that seemed to accrue from the application of this method, despite the paradox of its very disagreeable olfactory offensiveness. The memory of this dressing has also been very sharply revived by its analogies to the closed plaster of Paris method of J. Winnett Orr, of Lincoln, Nebraska, applied by Trueta and the Spanish surgeons on the Catalonian war front in the late civil war in Spain.

Guerin believed that septic infection in wounds was caused by contact with the atmospheric air, which brought to the wound an air-borne but unknown poison or miasm which,

* The notion of protecting a wound from infection by excluding atmospheric air is an old one. The germ of the idea is found in a treatise on wounds by Cesar Megatus, a Franciscan monk and professor at Ferrara, who lived from 1579 to 1647, but the first practical application of the method in modern times is attributable to Chassaignac, who, in connection with his system of tubular drainage (1858) recommended that the wound be closely covered with strips of plaster in order to exclude it completely from the air. (Ashurst. International Encyclopedia, vol. 1, p. 595, 1881.)

possibly acting as a ferment, caused inflammation and suppuration. He believed that if air could be excluded from a surgical wound, as in an amputation, septic infection would be avoided. He justified his view by comparing the benign behavior of a simple fracture in which the air was excluded from the seat of injury, and the disasters of compound fracture, also the effect of opening cold abscesses which were painless and apyretic as long as air was not allowed to enter the abscess cavity; and he also pointed to the comparative innocuousness of the subcutaneous operations of tenotomy in orthopedic surgery, with the formidable consequences of the open section of the same tendons and fascia. Therefore, he advocated the making of valvular incisions in draining pleural effusions and fluid collections in joints, which allowed drainage without admitting air into the cavity; also in doing subcutaneous osteotomy for bone deformities, etc.

Proceeding with this idea of preventing infection by the exclusion of air, he devised his subsequently famous cotton pack dressing which he used to special advantage in the treatment of amputation stumps of the lower extremity. After the amputation, preferably of the circular type, he made no attempt to approximate the flaps, but packed the whole wound with raw cotton wool so that the secretions could soak into the pack without impediment. After firmly packing the cavity of the stump or the space between the flaps, the stump and the entire limb was immobilized by enveloping it in a huge cotton wrap or covering made by many successive layers of cotton batting, all bound and held snugly together by wide and immobilizing bandages. This dressing, once applied, was not disturbed at least for two or three weeks. In the meantime, the discharges slowly permeated the dressings and became extremely foul and offensive, so that by the time they were removed they had become an intolerable nuisance.* Strange to say, when the dressings were removed and the great magma of pus and other decomposing material had been washed off, the raw surfaces of the stump presented a rosy, granular, and seemingly perfectly healthy appearance. Healing had progressed in a perfectly normal course despite the abundance of pus and saprophytic emanations. Under these conditions, the flaps were then brought together and held in contact with adhesive strips or interrupted sutures until complete union and cicatrization had taken place, the stump being again immobilized in a copious cotton dressing, which was cheaper and more available in Louisiana than in any other part of the world. The most notable feature of this cure was that, despite its stench and offensiveness after the dressing had been on for over two or three weeks, the patient recovered without any of the usual local and systemic complications of rival methods.

The reasons for the success of this method according to the author were: (1) that it kept away atmospheric contamination during the process of healing; (2) it allowed free drainage; (3) it kept the wound free from irritating washes and disturbing manipulations; and (4) it kept the amputated limb at rest while healing was going on. And that is precisely the experience that was renewed by the Spanish surgeons during the late civil war by the practice of the *closed plaster of Paris method*, in dealing with compound fractures and septic war wounds, which, despite its offensiveness, has yielded such surprisingly favorable results.

As the story of Alphonse Guerin and his method has some distinct bearings on the mode of treatment that preceded the adoption of the Listerian principles, it will not be inappropriate to make some reference to his personal career and to the fate of his method. Guerin was born at Ploermel, in Brittany, in 1816, and died in 1894, at the age of 78. He was elected surgeon to the hospitals of Paris in 1850. Three years previously he had advanced his theory of wound sepsis as dependent wholly upon "miasmatic" contamination of unknown origin through the atmosphere. In 1871, he first applied the occlusive dressing to amputations, which bore his name. In 1872, the members of the French national society of surgery were dumbfounded when he reported that out of thirty-four thigh amputations, nineteen had been saved by his method.

At that time septic infection in amputations, at the thigh, was regarded as almost inevitably fatal, and the military experience of the sur-

* It was this most disagreeable feature that made the Guerin dressing highly unpopular and restricted its use in the wards of its chief advocate (Dr. Lemonnier) who seemed to gloat with satisfaction at the discomfiture of his critics whenever they came to him with complaints about the odor of his patients, pointing to their comfort and feverlessness and their healthy, painless and healing wounds, when their dressings were changed and the secretions were washed away.

geons of the Franco-Prussian War (1870 to 1871) only too tragically confirmed this fatalistic prognosis. The postoperative mortality during that war was so frightful that the ablest surgeons in Paris felt compelled to close their wards. Trelat definitely quit all his work at the St. Louis Hospital after losing practically all his wounded. Gosselin, Verneuil and Nelaton, likewise dismayed by their mortality, hurriedly gave up their services. And the same thing happened in Germany, where Volkmann, Nussbaum, Thiersch and others had to stop operating for the same reason that prevailed in France and in other countries. It was during these tragic hours, when death seemed to stalk in the footsteps of the surgeon as if to complete the deadliness of warfare, that Alphonse Guerin came unexpectedly on the scene with his strange dressing, to bring hope and confidence to his disheartened colleagues.

It was about this time, during the siege of Paris (1870 to 1871), that Nelaton, at the Grand Hotel, which had been converted into a hospital, in despair at the seeming failure of surgery to stem the tide of infection and disaster, declared that "whoever triumphs over purulent or septic infection deserves a statue of solid gold."

While Guerin's simple "cotton bale dressing" was not based on a clear or demonstrable scientific principle apart from its definite aim at the exclusion of aerial contamination, its practical application constituted a real advance. It is not surprising, therefore, that for two years after the Franco-Prussian War Guerin enjoyed a just reputation as master of surgery in Paris, and that his office became the *rendezvous* for a continuous parade of students and surgeons who came to observe and learn from him a mode of treatment which, despite its serious defects, proved superior to all others. The reputation of Guerin, like that of Nelaton,* his contemporary, had travelled a long way beyond the national boundaries, but by a different route.

Besides his skill, he was quick and quite witty, as is shown by the following anecdotes told of him. On one occasion Guerin was called to Rome to attend Pope Pius IX, who was suffering from an ulcer of the leg, which he cured when other eminent surgeons who had preceded him had failed. The Pope in thanking him said that, in his opinion, he, Guerin, was "the greatest surgeon in the world," to which Guerin replied, "I bow in thankfulness to the judgment of your Holiness, which I accept unquestioningly, since it is infallible." On another occasion, after the great surgeon had auscultated the chest of the supreme pontiff, he said, "I shall be very careful, your Holiness, when I return to France, to let no one know that my head has rested on your breast, for if I did, they would soon cut off my ears to make relics of them." (Fourmestraux.)

* Nelaton's fame had spread especially in France and Italy because of the porcelain probe that bears his name. With his porcelain probe, devised for the purpose, he had discovered the long hidden bullet in Garibaldi's leg, at a time when a number of eminent surgeons had failed to demonstrate its presence. Of course this was long before the age of Roentgen and the x-rays.

MORITZ SCHUPPERT—PIONEER IN ANTISEPTIC SURGERY IN AMERICA

When Lister came to the United States in 1876, to preside at the International Medical Congress held in connection with the Centennial Exposition at Philadelphia, which was ten years after his first pronouncement of the antiseptic doctrine, he was no doubt disappointed at the indifferent impression that his teachings had produced in the United States. This was even more remarkable in view of the much closer relations of the United States to England than any other country and that the Germans, whose clinics were much frequented by admiring Americans, had adopted Listerism with great enthusiasm.

The reasons why American surgeons had been so slow in subscribing to the Listerian doctrine were well stated by Professor Robert F. Weir who, writing in 1877 (N. Y. Med. J., December, 1877, January, 1878) stated: "It is only lately that in America attention has been given practically to the teachings of Lister in respect to the treatment of wounds. In fact, aside from an article by Schuppert in the New Orleans Med. & Surg. J., little or nothing has appeared in our medical journals relative to the result of the so-called antiseptic method." The reasons given by Weir to account for the tardiness of American surgeons to try this mode of treatment were: (1) that the treatment, as enunciated by Mr. Lister "has been repeatedly changed in its details; (2) that it was too complicated and demanded the supervision of the surgeon himself, or, in a hospital of a carefully

trained staff of assistants; (3) that many who had tried it had been unsuccessful in the cases where the essay had been made; (4) but the most weighty objection which was asserted or entertained was the positiveness of the enunciation of the germ-theory in explanation of the process of decomposition in the secretions of a wound." While this was true, there was still another reason which Dr. Weir did not mention and that was the indifference, the hostility of some of the leading British surgeons, themselves, who sought to minimize the importance of the Listerian movement at home (Nunnelly, Savory, Paget, Wood, Humphrey, Spence, Callender, Bantock, and above all, Tait). But this opposition was offset later by the loyalty of Lister's pupils and associates and by the enthusiasm of the Germans, French and all the leading surgeons of the continental European countries, who ultimately recognized the merit of his labors and accorded him the homage due to one of the world's greatest benefactors.

In New Orleans (1877 to 1880) as previously stated, the faculty and the staff of the Hospital, in common with all the leading surgeons of the United States, were undecided, skeptic or frankly hostile to the method, the only exception being a German surgeon, Dr. Moritz Schuppert, graduate of the University of Marburg (1849) where he was born in 1817, who championed the cause in New Orleans. He had settled in New Orleans in the early fifties, soon rising to distinction as a very able operator and prolific writer, despite the short time he had to acquire a knowledge of the language. He was soon a member of the Hospital Staff, a professor in the Charity Hospital Medical School and prominent at medical meetings. Always a diligent student and omnivorous reader, he kept in touch with German literature, and it was from this source that he gathered the enthusiasm of his old friends and teachers in acclaiming the new era that had dawned in surgery with the advent of Lister and the antiseptic doctrine. In a lecture published in the New Orleans Med. & Surg. J. for January, 1878, Schuppert stated: "The astonishing reports which had reached me from the interior of Germany at the end of 1874, that the antiseptic treatment of wounds recommended by Lister promised to cause a revolution in surgical practice, did not permit me to rest, and the Spring of 1875 found me already on the road to visit those places where such stunning facts were reported. After my return to this city in the fall of 1875, I gave a resume of what I had absorbed in some of the most renowned hospitals of the European continent in a few lectures delivered in the amphitheatre of the Charity Hospital and reported in this Journal."

In this extensive monograph, Schuppert gives a most minute description of the antiseptic treatment, the progress it had made, especially in Germany under the leadership of Volkmann, whom he admired intensely and followed most closely; and he closes finally with a complete summary of his own experience based on his personal operations in New Orleans at the Charity Hospital in strict pursuance of the Listerian method during the period 1875 to 1878.

His summary embraces 120 miscellaneous operations including twenty-three amputations (major and minor), seventeen resections of bones and joints, two compound comminuted fractures of leg and thigh, five ligations of arteries in continuity, thirty-four cuts and stabs including larynx and pharynx, stab of chest, two gunshot wounds of abdomen (one death), three penetrating stabs of abdomen with no deaths, altogether 120 operations, besides forty-four chronic ulcers of the leg, treated antiseptically, with a total mortality of only 4 per cent.

He describes in minute detail the antiseptic treatment in the complicated and methodical ritual-like form of the early Listerian dressings, but modified and simplified by Volkmann and later by himself after his return to New Orleans. These details I learned personally under very impressive circumstances when it was my fortune to be called, as interne, to carry out the full program of antiseptic preparation for the extirpation of an enormous ovarian cyst in a patient admitted in the summer of 1878. The chief of my service, Dr. Wm. Carson, called on Dr. Schuppert to direct and assist him in the prospective ovariotomy which was to be the first performed in the Hospital under strict antiseptic precautions. This occasion gave me an opportunity to become acquainted with that remarkable veteran of surgery and his two sons, William and Charles, both graduates of medicine, who assisted him, particularly William, the eldest, who had recently arrived from Vienna after two years of study in the surgical clinics of that great and flourishing center of medical culture.

A COMPLICATED OVARIOTOMY UNDER THE SPRAY

The patient, a white woman of 55 years, presented a huge ovarian cyst of the gigantic size now never seen, but common enough then, when tumors grew unmolested in patients living in the rural districts, like the trees of a primeval forest which has never known the aggression of the sawyer or of the lumber jack. The patient had been tapped many times and the effects of these tappings were secondary peritoneal reactions followed by general adhesions which completely immobilized the sac. Besides, the tumor was so large that the patient, who was small, thin, and worn by prolonged suffering, seemed to have grown to the tumor rather than the tumor to her. "A very unpromising case" as Dr. Carson and Dr. Schuppert remarked. Under Schuppert's instructions, the patient was kept in bed and given the benefit of all the preliminary examinations and dietetic and hygienic care to fit her as much as possible for the operation. Miserable and discouraged, she begged to have something done regardless of consequences. Accordingly, a small operating room was chosen, away from the main theatre to avoid dust and an overcrowded audience. The night preceding the operation, the floors were scrubbed and covered over with sheets rinsed in a 5 per cent carbolic acid solution and the walls were also covered with sheets rinsed in the same solution. The tables for instruments and accessories were all draped in the same freshly laundered sheets which had been wrung out in the carbolic solution, the gowns of operators, assistants and nurses alone were exempt from the acid bath. The instruments, previously well scrubbed, were kept immersed in a 5 per cent carbolic solution. Large "elephant ear" marine sponges were kept immersed in the carbolic solution, ready for use in the abdomen.

The wash room was furnished with soap, brushes and a 5 per cent carbolic solution for hand scrubbing and disinfection. There were no caps, no masks, no gloves, as these were unknown at that time (1878). The abdominal surface was prepared in the usual way by applying a thin poultice of green soap, to be followed by a thorough wash of the softened skin with a 5 per cent carbolic water solution, leaving a thin towel wrung out of alcohol over the abdomen until the start of the incision. The drapery of the patient was all freshly laundried.

A hypodermic of morphia was given twenty minutes before the operation and the anesthesia started with chloroform dropped over an open cone. The anesthetist was an undergraduate intern, as it was the custom to give the residents practical experience.

Finally, a large steam atomizer was started to keep a steady spray of a 5 per cent carbolic solution continuously over the operating field.*

Schuppert often spoke of substituting thymol for carbolic acid as this was being done by Volkmann at Halle with satisfactory results, or salicylic acid which Thiersch was then trying at Leipzig. Neither of these was available at the Hospital and the classical carbolic solutions were used.

Finally, the moment for the operation had come but, despite the efforts to reduce the number of spectators they continued to squeeze in, always getting nearer the operating table in their street clothes without any overgown or other pretense of a cover to reduce the risk of contaminating the room, depending only on the spray to shield the field of the operation from air infection. As it was a hot summer day, the combined effect of the spray and the overcrowding of the small room, caused the perspiration to start freely on the forehead of the operator (Dr. C.) and his first assistant, Dr. William S., while the senior Dr. Schuppert, as director and counsellor, sat on a stool by the side of the patient with the operating field in excellent view. A nurse was kept busy from the start with a cold wet towel to wipe the perspiration which was streaming from the heads of the operators. There were then no electric fans, no air conditioning apparatus such as now makes operating more comfortable and even enjoyable, only palmetto fans which were forbidden for obvious reasons. The recollection of that hot, stuffy room under the sky lights on a bright summer day makes me realize the enormous advantage and comfort of modern air conditioned operating rooms, with no spectators in the way, and the powerful shadowless electric lights which make the skylights, and the placing of operating rooms on the top floors of the buildings, absolutely unnecessary.

Going back to the operation and the anxious operators, the pathology in the peritoneum was

* While these preparations were going on, my clothing became so permeated with the odor of carbolic acid that my classmates used to tease me by calling me Lister—"Mr. Lister, when will you serve that carbol lemonade?"

Bellevue (New York City) Hospital and anatomic theater. An operation in 1898. Note the chief surgeon wears an apron and works with his short sleeves rolled up. The anesthetist forgoes wearing his coat. Although rubber gloves had been in use several years, none of the operating room team is wearing them.

Bettmann Archives

found even worse than anticipated, for the cyst, with thickened walls, contained over six quarts of dark discolored serum, and the cyst was uniformly fixed and bound down by adhesions to the abdominal wall and intestines. In fact, it was only by extreme caution that an adherent coil attached to the abdominal wall immediately under the line of incision escaped injury. After working with great care for over an hour to detach the densely adherent bowels, the cyst was mobilized sufficiently to exteriorize two-thirds of the sac, leaving the last segment sutured to the abdominal incision where it could drain externally through a rubber tube. In the course of the detachment of the bowel from the cyst, the intestinal walls were so thin in places that they had to be protected by a reinforcing line of sutures, as in some places it was not certain that some gas had not escaped from minute tears. The abdominal incision had to be very much enlarged to deal with the adhesions, requiring much time to close it with the through and through silver wire sutures which were in favor at that time.

In the meantime, the carbolic spray was kept going, much of the atomized vapor settling on the incision and peritoneal cavity. Of course the wide retraction of the abdominal incision with the powerful automatic retractors of the present day were missing and the systematic dressing of the edges of the incision was not yet a part of the technic. The large, soft, "elephant ear," marine sponges did good service, and they would even now be of inestimable value were it possible to sterilize them by heat once they have served in the abdominal cavity.

Fine carbolized silk was used for the intestinal sutures and ligatures but the profusion of intestinal clamps and hemostats which we now find so indispensable in present day practice were not there. It is really remarkable, as I think retrospectively, how much good work was done by the two relatively young operators who were tackling, with no previous experience in the abdomen, one of the most formidable surgical problems imaginable, at that time. I was therefore not surprised when I heard Dr. William S. say, in a low voice, "Carson, this is terrible; it is almost inviting the patient to be present at her own autopsy."

The operation had to be hurried in its last stages, as the patient was showing signs of collapse. The abdominal incision was covered with a layer of Lister's protective, parafined gauze and several layers of superimposed carbolated cotton in compact gauze bags were laid over the abdomen, which had retracted into a deep hollow, lined with relaxed skin folds. The dressing was held by strips of adhesive (diachylon) plaster and a snug abdominal binder.

Clinical sphygomanometry was still unborn, but this was not necessary to tell that the patient was suffering from shock and exhaustion. Oxygen was not then in use or available, nor intravenous infusion of saline or dextrose, and, much less blood transfusion.

Adrenalin, ephedrin and pituitrin had not yet appeared on the horizon of surgical therapy. All that could be done was to put the patient to bed, warm her with hot water cans (no electric pads then) and give camphor oil and caffein and small doses of strychnia, digitalis, atropin and morphia by needle, with a pint of hot coffee given slowly by rectum (that was long before Murphy's proctoclysis had been introduced as the classic aftermath of every abdominal operation).

Fortunately, the patient rallied for the first two days and gave promise of recovery; but, unfortunately, nephritis set in with continued vomiting (not of peritoneal origin, but uremic) and progressive oliguria and, finally, total anuria, edema of the lungs, coma and death on the sixth day. To what extent the prolonged contact of the carbolic spray had to do with the suppression of the renal function, is not certain, but the toxic effect of the carbolic spray on the kidneys (carboluria), in prolonged operations over large peritoneal and raw surfaces had been sufficiently demonstrated to make the substitute of other less toxic antiseptics desirable. This objection with other reasons, well established by Volkmann and Thiersch, finally led to the abandonment of the spray as an obligate part of the Listerian ritual, by Lister himself, in 1887.

The history of this patient also offers a notable contrast between the powerful postoperative therapy of the present and the scant resources of fifty years ago.

Looking back to those anxious days and nights passed at the bedside of this unfortunate woman, I can imagine how much greater the chance of saving her life if we had had available donors for blood transfusion or a knowledge of the continued intravenous dextrose and salt drip, medicated systematically with adrenalin, and other cardiovascular stimulants as indi-

cated. Besides, what an enormous advantage the duodenal tube for gastroduodenal syphonage would have been as a check to the vomiting; and again, the aid of a constant stream of oxygen by nasal intubation would have contributed so helpfully to the whole plan of relief.

A LONG DELAYED RECOGNITION OF MERIT

In connection with the early history of Listerism in the United States, I believe there can be no question that Schuppert was its first apostle in America. As previously stated, he visited Volkmann and the German clinics expressly to familiarize himself with the method so that he might apply it at once on his return to America that year. He utilized his surgical clinic at the Charity Hospital exclusively for the practice of antiseptic surgery and was promptly recognized as its ablest authority and expert. He was also the first in Louisiana, as Dr. W. Carson's guide and consultant, to direct all the details of the antiseptic technic in the first ovariotomy performed at the Charity Hospital by this method. In this he preceded Dr. Ernest Lewis (the father of gynecology in Louisiana) who extirpated very successfully a monstrous giant tumor of the ovary estimated to weigh with its fluid content, sixty-five pounds(!). This operation was performed under rigorous Listerian rules; Schuppert also preceded another operation, the third in the same year (1878) in which Dr. S. G. Choppin, an associate and great friend of Schuppert, did a successful ovariotomy for a solid growth, of moderate size. Unfortunately, the Hospital records of all these cases were lost sometime in the early nineties when a fire in the attic of the Hospital destroyed a great collection of ward histories, including that of the patient just described, without leaving a record of the precise date it was performed, except that it (Schuppert-Carson patient) antedated all the others operated that year (1878). No report of the operations performed by Dr. Lewis and Dr. Choppin were ever published except for a brief account given by Dr. Lewis in his Reminiscences. (New Orleans Med. & Surg. J., pp. 744–766, April, 24, 1922.)

Despite the fine example set by Schuppert, the Listerian technic made slow progress in Louisiana and elsewhere in the United States. So learned and progressive a surgeon as Ashurst, of Philadelphia, in the second edition of his textbook of Surgery, which was the standard in all American schools for over a quarter of a century, said, in 1878, "the alleged superiority of the antiseptic method has not yet been demonstrated." And that opinion was expressed, let us remember, eleven years after Lister had issued his first announcement of the antiseptic doctrine. Professor Ashurst, sixteen years later, in his sixth edition (1895), —[fifteen years after my graduation in 1880]— wrote approvingly of the Listerian practice, but gave his blessing in a cautious way. In this he said, "I feel compelled to say that, while I cannot subscribe to the extravagant laudations which this plan received at the hands of his more enthusiastic advocates, I believe that, when used with judgment and diluted with common sense, it is capable of affording valuable aid." And this was indeed high praise when compared with the violent diatribes that Lawson Tait and his followers hurled against Lister and his gospel.

It is doubtful that the Listerian dressing in full ritual, of the early period, was ever applied in New Orleans outside of Schuppert's clinic. But surgical cleanliness based upon a clear conception of its germicidal purpose, with special regard to the preoperative care of the surgeon's hands and the shaving, scrubbing and washing of the field of the operation, followed by carbolated compresses, was beginning to tell for the betterment of the surgical and obstetrical services. But even in the eighties, *noli me tangere* was written large on the head, chest and abdomen, and their contained organs were still held as in sanctuaries which no one dared to open with unhallowed hands. Surgery was still largely restricted to such interventions in the visceral cavities which were made compulsory by accidental injuries and imperative vital indications. Apart from fractures, dislocations, and the usual accidents that are common to metropolitan and industrial life, the conditions for surgical treatment did not constitute more than 15 or 20 per cent of the indications that call for surgery at the present time. Peritonitis was treated as a disease without regard to its cause. It was a notable event when Homans, of Boston, on May 4, 1886, actually opened, for the first time an intraperitoneal abscess without identifying the appendix. The mere fact that a nonencysted acute intraperitoneal abscess, presumably caused by a suppurating appendix, had been intentionally sought for and opened by an abdominal incision, was regarded as a

very audacious procedure (Med. Rec., New York, May 1, 1886). Operations for hernia were limited strictly to the relief of the strangulation. No laparotomies for perforating wounds of the abdomen were performed, and opium was the only and universal remedy.

The Charity Hospital of New Orleans, a state institution which dates its existence from 1832, showed a record of only 172 operations in 5,300 admissions during the year 1881, or a little over 3.2 per cent; and of these, seventy-two were amputations, thirty-two incisions for abscess, three ligations of arteries, eighteen extractions of projectiles, and one single laparotomy! In other words, 96 per cent of the cases admitted were medical and 4 per cent were surgical.

In 1890, the year when the American Journal of Surgery was founded, there were 6,083 admissions, including 291 important operations. In other words, 95 per cent admissions were medical and 4.7 per cent surgical; evidently no very great progress had yet been accomplished in the expansion of surgery.

But now in 1940, after the lapse of a semicentury of history, we find that out of 58,889 admissions for the year ending July 1, 1939, 23,473 were surgical. In other words, the treatment of disease in this hospital, which in 1881 had been a little over 3 per cent surgical, in 1940 has become 40 per cent surgical.

The experience of the Charity Hospital in New Orleans is only one example of the effect that the Listerian revolution created in hospital practice throughout the world. But this progress as we have indicated was accomplished gradually, very slowly. The year 1890, however, marked the most rapid advance. Every year after that recorded some new territory invaded, some new operation or new technical acquisition that improved and added to the dominion and security of surgical operations, especially those of the abdominal and other visceral cavities. By the end of the nineteenth century (1890 to 1900) surgeons had less dread of opening the abdominal cavity than their predecessors in performing even a minor amputation of the extremities. Abdominal surgery, especially that of the pelvic cavity, had gone so far in dealing with ovaries, uterus and adnexa, that in 1895, Dr. Chadwick, of Boston, president of the American Gynecological Association, felt it incumbent, in his presidential address, to protest in the name of gynecology against the great excesses that were being committed in the female generative organs.

STEAM AND THE "BOILED HAND" SPEED SURGERY TO NEW CONQUESTS

By 1895, the Listerian ritual had been divested of almost all its formulas, and dry heat and steam sterilization had largely replaced chemical sterilization, except in the preparation of the skin and operating field which could not be subjected to sterilization by heat. At the same time rubber gloves introduced by Halsted, in 1890, had created the equivalent of the "boiled hand" which not only gave infinitely greater security to the manipulations of surgery, but protected surgeons' hands from the harshness and injurious effects of the chemical antiseptics of all sorts, which had been ineffectually tried in infinite ways before the boilable rubber gloves were introduced. All that remained, seemingly, as a source of infection in surgical wounds was the possibility of atmospheric contamination, which had been long since relegated to a secondary plane as a negligible quantity when the spray was abandoned as unnecessary, even by Lister himself. In this way the antiseptic practice of Lister by chemical sterilization had undergone radical modifications, while still retaining the integrity of its fundamental principles, namely, the prevention of infection in clean, uncontaminated surgical wounds and the sterilization of wounds already contaminated or infected, in which chemical sterilization still had its application. Antisepsis had yielded to asepsis, a word which Lister himself had coined to indicate a state free from sepsis or infection.

Roentgen's discovery of the x-rays came in 1895–1896 to inaugurate a new agent of transcendent importance for the development of surgery. By illuminating the body, diagnosis was marvelously simplified and immediately the indications for surgery prodigiously multiplied.

Roentgenology supplemented by the constantly growing collaboration of the physiological and biochemical laboratories, all combined to so rejuvenate and transform the face of surgery that it was no longer recognizable in the light of its ancient portraiture.

HALSTED—TEACHER OF SURGEONS*

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THE effects of the perspective of time are deceptive. As the great figures of history recede into the dimness of the past, the physical reality of their persons if not completely forgotten becomes strangely blurred or distorted. Detached from their concrete beings, the names of the famous who made history become synonyms for abstract ideas or (a less attractive possibility) the cloak for hollow slogans. We speak of the sanctity and wisdom of the law, of liberty of speech and of the written word, and of the freedom of religious conscience, yet we are hardly aware of the material existence of Solon or Voltaire or John Knox who among many others lived and worked and fought and died so that these ideas, once only abstractions of the human mind, might become the palpable realities of a later day. And how often we hear empty verbiage on "government for the people, by the people" only to remember, in reproach and regret, the gaunt figure of Lincoln who lived, not talked, democracy.

In the history of science the transformation of the individual is somewhat different. In science the achievements of the truly great, as if by forces derived from life itself, come slowly to grow into the organism of our everyday existence; it seems to be their fate that the details of their persons dissolve into the results of their work, making life richer and perhaps happier. Measured by this standard William Stewart Halsted must certainly be looked upon as one of the truly great. His contributions to surgical craftsmanship and his ideals of what the goal of the surgeon's aspirations must be have become so organically integrated with the concepts and standards of our day that they seem wholly impersonal, wholly divorced from the man who is responsible for them. Yet these ideals were born from the labor of a very concrete person, Halsted. To understand truly what this means we must cast a glance through the distance of almost sixty years at this man and the historical setting of one of his greatest achievements—perhaps *the* greatest—the laying of the foundation of the modern concept of surgical training in the United States.

It is perhaps a truism, but one not unworthy of repetition, that the fate of a man, even of the greatest, is shaped by the sum of the immutable forces of his innate qualities and the unpredictable and often capricious forces of his material environment. Halsted's life well shows the interplay of these forces. He was born with attributes that many will place in the front rank of the essential endowments of a scientist: a mind aware and even respectful of tradition but not blinded by it and an untiring will to achieve perfection. He was, on the other hand, also favored with fortunate circumstances needed for the full growth of these qualities.

The son of wealthy parents, Halsted had the means to travel widely in Europe after his graduation from the College of Surgeons and Physicians in New York (1877) and he kept the custom of visiting Europe frequently for many years. These experiences made an imprint on his mind that one can trace throughout his life's work. One result of his travels was that although sturdily American in background, outlook and character he acquired early an intellectual and cultural cosmopolitanism so important for breadth of vision. In a practical way and with a more direct influence on his work as a surgeon and teacher his visits to Europe and especially to the German-speaking countries acquainted him intimately with European medicine at a time when it was making its greatest and fastest strides in its long history.

It was the age of medical renaissance in Europe. The science of bacteriology had just been born and physiology and microscopy were growing prodigiously. In the young German empire a great cultural achievement was coming to fruition (perhaps the only enduring accomplishment of an autocratic order of life), namely, the generously supported state university, highly organized, academically free and

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† Deceased soon after this was written (March 31, 1951).

The Four Doctors by Charles S. Sargent: Howard A. Kelly, William Osler, William S. Halsted and William H. Welch.

rich in teeming laboratories. German clinicians had been the first to grasp the practical meaning of the scientific revolution that the discoveries of Rudolf Virchow, Louis Pasteur, Robert Koch, Joseph Lister and others had accomplished. They strove with mighty energy to integrate the fundamental sciences with clinical disciplines and their efforts placed German medicine at the head of progress. As the years passed, Halsted became intimately acquainted with many of the leaders of European academic life such as Johann v. Mikulicz-Radecki, Anton v. Eiselsberg, Werner Koerte, Hermann Kuettner, and in particular, Theodor Kocher. These friendships remained a source of lifelong inspiration.

The greatest opportunity of Halsted's life was undoubtedly his appointment to the chair of surgery at Johns Hopkins University. There is a poignant lesson in the way this opportunity came about and in the manner in which Halsted took marvelous advantage of it, for the opportunity was unforseen and Halsted seemingly unprepared for it.

The Johns Hopkins University had been founded on the bequest of the man whose name it bears under conditions hardly different from those that had marked the beginning of many other American institutions of learning. There was one circumstance about the birth of the new university, however, that was new in a revolutionary way: it was to include within its academic organization a hospital and a medical school dedicated entirely to teaching and research. This was the first time that a privately endowed university undertook such a goal. The idea has since become commonplace, but then so great were the practical obstacles in its way that its realization would very likely have been impossible but for the exceptional energy and organizing skill of the first president of the new university, Daniel Coit Gilman, and of the first dean of its medical school, William H. Welch.

The medical school of Johns Hopkins University, opened in 1884, soon acquired great prestige to which it indeed had several strong claims. The richness of its endowment and the unselfish purpose of its being dedicated to teaching were omens of a bright academic future. The entrance requirements of the school were so high as to command respect and to assure an unusually high quality in its student body. Not only a high school diploma (which was the highest contemporary prerequisite to a medical education) but also a college degree were required for admission, with a reading knowledge of French and German and a considerable amount of work in the basic sciences. The stress on the fundamental sciences of medicine was marked in the preclinical years and its practical results were assured by the appointment to the faculty of such men as William H. Welch in pathology, Franklin P. Mall in anatomy, John J. Abel in pharmacology and William H. Howell in physiology (the last three of whom, by the way, had been at the University of Michigan, a school that at the time possessed one of the finest bodies of medical educators in the world). In the clinical branches William Osler was invited to the Chair of Medicine, Howard Kelly to the Chair of Gynecology and William Macewen* to the Chair of Surgery. The first two men accepted but Macewen, after some delay and for personal reasons, refused. Thus came about the most portentous event in Halsted's life.

Halsted was in Baltimore at this time (1889). He had had a considerable amount of surgical and research experience before coming to Baltimore but did not have a particularly outstanding reputation. He had been house officer at New York Hospital and attending surgeon and physician at Bellevue Hospital. The accomplishment for which he had been best known until then had been the organization of the most popular student quiz courses, a form of private tutoring in great vogue as preparation for medical school examinations. Indeed, what he had brought from New York had been not so much professional fame as the burden of the fresh memory of a tragic and almost fatal happening.

While working at Bellevue in 1885 Halsted had experimented with the clinical use of the

* Macewen then held the position of visiting surgeon to the Royal Infirmary in Glasgow, Scotland. Already internationally known, he was to become Regius Professor of Surgery in the University of Glasgow and one of the outstanding figures of British surgery. The circumstances of Halsted's appointment were not common knowledge at the time; he related them to me on the day when in 1908 he took me as his guest to Washington, D. C. The purpose of this trip was to attend on September 30th of that year the meeting of the International Congress of Tuberculosis, an event made memorable by the presence of the great Robert Koch who delivered in English a dissertation on the relationship between human and bovine tuberculosis. (*R. D. McC.*)

Johns Hopkins Hospital, Baltimore, Maryland, 1914.

new anesthetic, cocaine. (In fact he was the first to do so in the United States.) The drug had been little known and there had been no suspicion that it might be habit forming. As some others, Halsted had tried the new preparation on his own person and unwittingly had become addicted to it. After a desperately difficult struggle he overcame the effects of the drug. His recovery, which in spite of whispered rumors was complete, was a great feat of will power, but with all his fundamental soundness of character it might not have come about without the help of Welch whom Halsted had befriended during the latter's work at Bellevue (1880). Welch hovered over the stricken Halsted with the devotion of a father, and the tragic illness of Halsted bound closer than ever their friendship that endured through life.* When Halsted was well again, he was invited by Welch to join him in his laboratory in Baltimore.

Besides the deepening of his friendship with Welch and his settling in Baltimore Halsted's unhappy experience seems to have brought about another result of perhaps even profounder significance. In his New York years Halsted had led an active social life, and although already showing signs of the inquisitive mind of a born investigator, seemed to be attracted first of all to the practical aspects of surgery. His misfortune apparently turned him inward. Without committing the sin of overstressing the effect of an external event even as overwhelming as Halsted's drug addiction, one may observe that after his recovery he became ever more absorbed in his work, a more retiring, more distant but also a deeper personality. Perhaps his illness had in the final reckoning made him better prepared for the work for which he was destined.

In any event Halsted was doing research work in the laboratories of Welch and the anatomist Mall, studying some aspects of intestinal suturing,† when in 1889 the search for the first Professor of Surgery in the new medical school met a setback in Macewen's refusal. To the mild surprise of everyone, in October of that year the trustees named Halsted to be Associate Professor of Surgery and Acting Surgeon-in-Chief. Whether the choice of the trustees was meant to be a temporary arrangement until a man of wider fame would be found

* The details of this illness were related to me in 1914 by Dr. Frederick Shattuck, later Professor of Medicine at Harvard Medical School, who had been intern in the hospital in Connecticut where Halsted had been taken by Welch for treatment. (*R. D. McC.*)

† He was the first to demonstrate that sutures through the intestinal wall in order to hold firmly must include the submucosal layer.

or whether the appointment was to be permanent with the condition of Halsted's proving himself worthy of it, is not clear. It is probable that the trustees were well acquainted with Halsted's potentialities through Welch and only needed signs of assurance of Halsted's complete recovery from the drug habit. Whatever doubt they had was soon dispelled. Halsted's ideals and character as a teacher, his ability as an investigator and his skill as a surgeon soon proved him to be fitted ideally into the organization of the recently born university. In 1892 at the age of forty he was made Professor of Surgery and Surgeon-in-Chief.

In this position Halsted found a perfect opportunity for turning into reality his ideas on surgical training, ideas that had been maturing for some time. They had begun to form when in his years in medical school he first came in close touch with the shortcomings of medical education. They became clearer and stronger during his early travels and they continued to grow as he compared the conditions of postgraduate teaching in the United States with those in Europe.

About the time that Halsted assumed his professorship medical education in the United States had not yet fully entered the period of history that was to mark the greatest step forward in its development. Although the period of transition from commercialized, poorly equipped and irresponsible proprietary schools to the endowed or public-supported schools of high purpose and elevated standards was beginning to get under way, almost twenty years had to pass before in 1910 the Flexner report was published, sounding the deathknell of the medical diploma-mills. Training in the specialties was passing through no less critical times. It was not until 1916 (nearly twenty-five years later) that the first attempts were made at establishing official standards of training and at certification of specialists by the founding of the American Board of Ophthalmology.

A surgeon's training in the United States was in 1893 still a matter of personal will with little practical opportunity of realization. There were a few teaching hospitals that offered eighteen months or two years of training as house surgeons, consisting mainly of operating room work but little planned and organized instruction in correlating the fundamental sciences with clinical diagnosis and treatment.

Under such conditions most surgeons were self-taught. It is really surprising that even in this unfavorable climate many outstanding surgical craftsmen grew up, for there were such, and the best of them were the equal of the best in Europe. This autodidactic system, however, inevitably led to a clanishness among the leaders and a great scarcity of teachers. The self-made surgeon was not inspired to hand down his hard-earned skill to generations striving to learn. The young man who wished to become proficient had to travel the same stony road as his predecessors had. Nor did the non-material reward of academic life hold out much inducement to the man of practical outlook; many professional chairs were difficult to fill with able men. And as many of the leading practitioners of surgery worked in isolation from the seats of medical learning, there was a disassociation of research from practice, a slowing of the diffusion of new knowledge and a want of intellectual stimulation within the profession.

The contrast with the European standards of training with which Halsted became familiar during his visits was indeed striking. He was particularly impressed with the German system of training.

This system, which with relatively little change remained for many years the standard for all the German-speaking countries as well as for the Scandinavian lands, had two outstanding characteristics: (1) a rigorous but highly successful blending of the basic sciences with practical clinical teaching under full-time professors and (2) a merciless competitive spirit among the young surgeons in training, with rewards only for the brilliant and strong-willed. The system worked somewhat as follows:

In his third or fourth year the talented student would make his choice of the field in which he believed his interests lay. If it was surgery, he would petition for a position as demonstrator or voluntary technician in the laboratories in one of the ancillary basic sciences, usually anatomy or pathology. He would help with simple research projects and do his best to establish a reputation with the head of the *Institut*, that is the *Professor ordinarius* of the specialty, in which he wished to obtain an assistantship. Upon graduation and at the completion of his internship (which was an organic part of his curriculum) he would, if fortunate enough to be appointed, embark on his assistantship. He would now be

in the thick of competition among ambitious young men the goal of all of whom was the first assistantship. There was no set length of time leading to his position as there was no established number of assistants or an orderly sequence of succession. The first assistant would hold his position until called to a chair in a small university or until becoming tired of waiting and going into practice with the distinguishing title of *Privatdozent* as a remembrance of his days of academic glory. However, even if many of the assistants would not make the highest grade, during their days of training they gained valuable knowledge by doing research, learning operative technic, teaching on the wards and above all gathering a lifelong inspiration from a great teacher.

This harshly competitive and exceedingly selective system was aimed at the goal of making future teachers. In this it was highly successful. Great surgeons literally bred great surgeons. To name one instance, Billroth's school produced among many lesser lights Johann v. Mikulicz-Radecki, Vincenz Czerny, Anton Woelfler and Anton v. Eiselsberg who in time all came to occupy important chairs of surgery. It had, however, a serious shortcoming. The group of less talented or less fortunate young men who never reached the academic peak but became skilled and conscientious practitioners were merely a by-product and their number was not large enough to supply the demand of the public for competent surgical care. Thus the average quality of surgery performed in the countries devoted to this system was and remained for a long time relatively inferior.

By his own admission* when he fashioned his system of residency Halsted had the German pattern before his eyes; yet it was not a slavish imitation. From the beginning there was a more clearly defined pattern of organization and division of duties, there was a larger volume of operative material at the disposal of the residents, a more intimate contact with practical clinical problems and a somewhat less preoccupation with pure science.

Originally Halsted had four interns and one extern, who was an assistant in surgical pathology. The interns served for one year, only the honor men of each class at graduation having been entitled to these positions. Above these three were three assistant residents of varying years of service. At the top was the resident surgeon who usually had served six years following graduation before attaining this position. Men in any part of the country, if they had the proper training, were eligible for these positions although few were chosen from outside Hopkins. Great care was exercised in the filling of the vacancies on the staff which occurred once every two or three years, and advancement was not guaranteed the appointee. The resident surgeon's term of service was variable. He received the salary of $40 a month after six years of hard and faithful service; the other assistants were not paid although all received board, room and laundry. The assistants were expected, in addition to their operating room and ward duties including the supervision of the interns and medical students, to prosecute original investigations and to keep in close touch with the work in surgical pathology, bacteriology and physiology. The total number of years of training of most of the resident surgeons was around eight.

The resemblance between Halsted's residency system and the German system of training was obviously close. In their concern with quality rather than quantity the two systems were practically identical. The emphasis on competition in the search for quality was carried to a degree that later aroused the accusation of exclusiveness. It is undeniably true that Halsted had no intention of training a large number of competent surgeons that would go out to heal the sick. He aimed at teaching the unusually gifted that they in turn might teach others. This is not a goal that one must have in mind when one sets up the average requirements of surgical training. Halsted's aim was not an average goal; nor were the means by which he approached his goal average. From the vantage point of the present day we may say that his concepts of training were perfectionist to the point of impracticality. Although this may be debated to the extent that it is not practical to apply his standards to the problems of training of the average competent surgeon of today, those concepts were in happy accord with the demand of his time.

* Halsted delivered a remarkable address on his ideas of medical education at Yale on January 27, 1904, entitled "The Training of a Surgeon." The address was later published in the *Bulletin of the Johns Hopkins Hospital* (15: 266–275, 1904) and ought to be compulsory reading for everyone concerned with the education of surgeons.

Operating room scene in the new surgical building (circa 1904). Reading from left to right around the operating table: Joseph C. Bloodgood; William S. Halsted, operating; Hugh H. Young; Owen, orderly; Miss Crawford, nurse; Harvey Cushing; John M. T. Finney; William F. M. Sowers, anesthetist. Note ether cone. Halsted had introduced rubber gloves but face masks were not used in 1904 when the surgical building was opened. The portion of a man shown sitting on the steps is Fred Baetjer, who was the first radiologist when Halsted established an x-ray division in surgery; he died a martyr of x-ray cancer after having undergone 120 operations in search of cure. The feet of James T. Mitchell are shown as he was leaving the operating room.

This demand was for teachers, and the surgeons that Halsted trained had the qualifications of teachers. Indeed, a very large proportion of his resident surgeons and assistant residents passed on to occupy chairs of surgery in the expanding scene of medical education throughout the country. Halsted's ideals were thus taken to the four corners of the land and were then handed over to a new generation to continue. The process was a planting and a harvesting of ideas and it grew almost as rapidly as the planted seed. Halsted's concepts thus evolved into a force in medical education far more powerful than the mere number of the persons involved in their spread would suggest. (During the thirty-three years of his tenure Halsted appointed altogether only seventeen full resident surgeons.)

The influence of Halsted's contributions to the practice and teaching of surgery cannot be better measured than by listing the roster of these men and sketching their accomplishments. One may start with the group that gathered together in 1914 on the occasion of the 25th anniversary of the opening of the Johns Hopkins Hospital.

John M. T. Finney played a very important part, especially in the early days, in the teaching of clinical surgery. He was not actually ranked as a resident surgeon at any time, having come to the Johns Hopkins Hospital at the completion of his formal training as house officer at the Massachusetts General Hospital. Later on, after Woodrow Wilson's resignation, he was elected president of Princeton University but did not accept the honor as he believed surgery was the only field of work in which he could be content. During World War I he took the Johns Hopkins Hospital Unit to France and was rapidly promoted to the rank of brigadier general, becoming the top consultant surgeon in France. After the death of Halsted

Reading from left to right: Roy D. McClure, Hugh H. Young, Harvey Cushing, James T. Mitchell, Richard H. Follis, Robert T. Miller, John H. Churchman, George J. Heuer. Seated: J. M. T. Finney, William S. Halsted, Joseph C. Bloodgood. This picture was taken at the reunion held in commemoration of the twenty-fifth anniversary of the opening of the Johns Hopkins Hospital (1914). Walter Dandy and Mont Reid. Assistant Resident Surgeons, witnessed the taking of the picture.

in September, 1922, he became Acting Surgeon-in-Chief. From June, 1923, until July, 1925, he held the rank of Surgeon-in-Chief.

At the time that the photograph was taken Joseph C. Bloodgood, although still very active in the operating room, had charge of the laboratory of surgical pathology. He was most active in cancer education through the country and was Chief Surgeon of the St. Agnes Hospital in Baltimore.

Standing on the extreme right of the photograph is George J. Heuer who was leaving at that time to go to Kuettner's Clinic in Breslau as an exchange resident. Later Heuer was called to the University of Cincinnati as Professor of Surgery and eventually became the first Professor of Surgery in the new Cornell Medical Center on the East River in New York and Surgeon-in-Chief of the New York Hospital. He developed very fine resident systems in both institutions.

John H. Churchman, standing on the right of Heuer, went to occupy the chair of Surgery at Yale. Poor health soon overtook him.

Robert T. Miller left the residency at Hopkins to become Professor of Surgery at the University of Pittsburgh and later Associate Professor of Surgery at Johns Hopkins.

Richard H. Follis, one of Halsted's favorite and most devoted residents, remained in Baltimore to teach at Hopkins but never attained professorship.

James F. Mitchell attained great prominence as a surgeon and teacher in Washington where he settled at the conclusion of his residency.

Harvey Cushing, who of the group made an imprint on American surgery second only to Halsted's, had left Baltimore three years earlier to become Professor of Surgery at Harvard and Surgeon-in-Chief of the new Peter Bent Brigham Hospital. Cushing had been attracted to the problems of brain surgery early, and after his return from Europe following his residency he asked for the opportunity to pursue this specialty. Cushing's choice at first did not find favor with Halsted, for although in general he encouraged specialization* he did not believe that there was enough neurosurgical material available to keep Cushing busy. Yet when Cushing left for Boston he had over forty beds occupied by patients with brain tumors. In Boston Cushing introduced the Halstedian system of resident training and afforded opportunities to many men who are now outstanding surgeons throughout the country. His achievements in creating almost single-handedly the specialty of neurosurgery are too well known to require comment here.

Hugh Young was another man of tremendous energy and of inquiring mind. At first working under adverse conditions he ultimately built the physical plant of one of the most modern urologic clinics of the day and developed his own school of urologists, contributing greatly to the science and skill of that specialty. His residents went forth to all parts of the country to perpetuate his teachings.

The last man in the photograph is the senior author, then resident surgeon. Some of his assistant residents were standing by while the picture was taken, among them Walter Dandy who was first assistant resident and Mont Reid who was second assistant resident. Walter Dandy followed in the residency and later developed a great neurosurgical clinic. Mont Reid took Heuer's place at the University of Cincinnati as professor of surgery. Barney Brooks, now professor of surgery at Vanderbilt University, was an intern on the staff at that time.

There were, of course, many others who were not present on the day this photograph was taken—those who had already gone and those who were yet to come. Among these who in various capacities on the resident staff came under the influence of Halsted's teachings were George Blumer, John L. Caulk, Willis D. Gatch, Emil Goetsch, Jean P. Pratt, Harry Plaggemeyer, Frank Hinman, Emile Holman, B. Noland Carter, Howard C. Naffziger, F. L. Reichert and many others.

Out of the strivings of these men grew a school of surgery that bore an unmistakable stamp—the stamp of Halsted. Halsted's disciples, of course, possessed their individual facets of talent and character that reflected the teacher's influence in many specifically personal ways. Certain traits, the Halstedian traits, however remained common to them all. Halsted was the sturdiest exponent if not the originator of the operative technic that placed

* Halsted's contribution to the encouragement of the growth of subfields of specialization in this country is worthy of particular note. His counsel was instrumental in directing the endeavors of several of his residents and assistant residents to specialized areas where they might do fruitful work. Among many are S. J. Crowe (in otolaryngology), H. H. Young (in urology) and F. H. Baetjer (in roentgenology).

An early informal photograph of three of the famous quartet shown in Sargent's Johns Hopkins painting. From left to right: Halsted (1852–1922), Osler (1849–1919), Kelly (1858–1943).

Bettmann Archives

care in dissection, gentleness in handling and infinite patience in attention to detail far above speed, boldness and brilliance. In like manner he introduced material and instrumental aids to surgical craftsmanship that marked great progress and some of which have endured to the present day.* Yet these contributions do not contain the true spirit of Halsted. The core of that spirit was in his outlook upon the duties of the surgeon and in his approach to the problems of surgery. His outlook was uncompromisingly altruistic and honest and his approach consistently original and rigorously scientific.

It was to the great good of American surgery that Halsted also had the ability to inspire in the young men he chose for his assistants, to the limits of their innate gifts, the same splendid traits that characterized his own work.

The quality of surgery performed in the average American town by the average American surgeon has improved immensely since 1889 when the direction of the surgical department of the Johns Hopkins Hospital came into Halsted's hands. The qualifications of the doctor who may call himself a surgeon have been standardized and codified. Opportunities for the young man with ability and willingness to become a surgeon have multiplied considerably. In its methods surgery has become much more the science it has always striven to be, and in approaching the scientific ideal it has grown in honesty of purpose.

When one contemplates these great strides already taken toward an even better future, one is reminded of the pupil's gratitude to his teacher, for all of us who share the skill, knowledge and honor of modern surgery through the inheritance of the ideals and precepts to whose realization Halsted devoted a long life of work, whether we ever sat in his classroom or not, owe him the pupil's unpayable debt of gratitude.

Acknowledgment: The authors wish to express their thanks to Dr. Alexander W. Blain, publisher of the *Alexander Blain Hospital Bulletin*, for permission to use some of the material as well as the illustrations which appeared in the article, "The Halsted School of Surgery," by Roy D. McClure published in that journal in May, 1947, volume 6, pages 30–39.

* To mention one: the use of rubber gloves.

PREVENTION OF TRAUMATIC INJURY TO THE BILE DUCTS*

A STUDY OF THE STRUCTURES OF THE CYSTOHEPATIC ANGLE ENCOUNTERED IN CHOLECYSTECTOMY AND SUPRADUODENAL CHOLEDOCHOSTOMY

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THE operative treatment of disease of the gallbladder and of the hepatic ducts has had a gradual and ordered evolution. The results of such treatment have improved until they are now, in general, excellent. However, it is disquieting to learn of the number of patients who have in the course of such operative treatment suffered injuries to the ducts that have resulted in disability or in death.

Some of these injuries have been recognized, reported and commented upon by many surgeons. One may assume that many others have not entered the literature. One can only praise the many ingenious technical procedures that have been made to correct the original injuries. With due respect to the thoughtfulness of the surgeons who have made these suggestions which have been so carefully developed and painstakingly carried out one may well inquire why so many ducts have been injured and wonder whether the surgical teaching of the last few decades may not have been contributory to the production of these surgical tragedies. We have been urged to perform a cholecystectomy for every patient with acute cholecystitis. We have been urged to remove all of the cystic duct since it may later produce symptoms by its dilatation. We have read of large series of cholecystectomies carried out without drainage, without morbidity and mortality. We have been urged to explore all common ducts regardless of indications since stones may lurk therein. All of these surgical teachings have a background of truth, but one should examine them carefully in the light shed by the large number of injuries to the common duct reported in the literature. In spite of the numerous suggestions made for correction of this surgical error the results in the hands of the most skillful and by any method leave much to be desired.

Drainage after cholecystectomy is seldom important; however, occasionally it may be the only indication of a collection of bile which if untreated or unrecognized may give rise to peritonitis and death. It may be important to remove all of the cystic duct; but if in the rare case the residual duct gives rise to symptoms, it can be easily corrected and it is just another operation and not a tragedy. If one drains the gallbladder in acute cholecystitis when the anatomic landmarks are obscured, a secondary operation may be necessary; but again it is one easily planned and performed, and the biliary ducts are still intact and functional.

Any or all of these auxiliary procedures can be effected without risk or worry, but a divided or stenosed duct with or without bile peritonitis is a problem without a certain happy solution. It is axiomatic that a better knowledge of the anatomy of the area and of its common variations will be helpful in avoiding surgical errors. One of us (D. A. M.) has made studies of the area involved that should be helpful. These dissections demonstrate the frequency of accessory ducts which are not usually discernible at operation and suggest the wisdom of drainage. They point out the variations in the duct relationship and indicate the safety of leaving a measured length of the cystic duct. The variations in the arterial supply emphasize the necessity of careful dissection of these structures rather than the crude clamping of an undissected pedicle. This study is offered not as a substitute for the many careful anatomic investigations of the variants of the ducts, arteries and veins but as a practical analysis of the anatomic features in the area implicated in the operation of cholecystectomy. A knowledge of the anatomy of this area is all important for successful therapy. In addition to this knowl-

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edge if one will be restrained in attempting too much in operations for acute cholecystitis when anatomic landmarks are obscured; if one will recognize the frequency of accessory ducts and drain that their presence may be known; and if one will admit that a certain length of cystic duct usually does no harm, there will be many fewer injuries to the main ducts which are always catastrophies in spite of the many ingenious methods for their repair that have been devised.

Variations of the arterial and duct components of the hepatic pedicle have been known for a long time. These, however, have not found their way into the somewhat abbreviated descriptions and illustrations of the biliary duct system and ramifications of the hepatic artery in many of the standard anatomy textbooks the study of which leads one into a false sense of security. Confusion and perplexity, on the other hand, may follow the perusal of excellent but complicated reports of these variations in the literature. Both tend to obscure rather than clarify this important region in the mind of the surgeon.

Examination of the well known list of complications following biliary duct system surgery reveals among others hemorrhage, bile peritonitis, stricture of the ducts, biliary fistulas, obstructive jaundice and hepatic insufficiency. The latter in fact may result from one of the preceding, from liver disease or from ligation of one of the main arterial channels to the liver. Without entering the discussion as to what may be the major cause of these complications it is profitable to evaluate the anatomic variations found in this particular region. In examining this area one or more of the following abnormalities may be encountered: (1) chronic inflammatory changes with edema, thickening, scarring and adhesions, (2) anomalies of the duct and vascular systems of the liver and gallbladder and (3) unrecognized variants of the usual course and appearance of the ducts and blood vessels from scar tissue retraction and chronic inflammation. Certainly the surgeon has no control over the first; however, he ought to be familiar with the second and be ever on the alert for the third. Many authors[2,3,11,12,14,17,18,23,26,38,39] have urged the utmost caution in this vital area.

It seems reasonable to assume that some region "within the operative area" of the hepatic pedicle might contain the majority of these variations and that once they were identified here, along with other normal structures, the risk of their unintentional injury should be materially reduced. Indeed it would appear advantageous to approach this problem from the viewpoint of the surgeon in the operating room examining the particular structures encountered during operation, in this case cholecystectomy and supraduodenal choledochostomy, and not restrict oneself exclusively to the dissected cadaver in which reconstruction of the region is not necessary, time is not a factor and exposure is unlimited and under ideal conditions.

With these considerations in mind the hepatic pedicles of 250 cadavers (209 male, forty-one female) were dissected and analyzed. The dissection of each specimen was carried out in two stages. The first stage consisted of dissection of the cystohepatic angle and that portion of the hepatic pedicle necessary for the safe performance of cholecystectomy and supraduodenal choledochostomy. The second stage was a more extensive and detailed anatomic dissection of the hepatic pedicle, celiac axis and the hepatoduodenal ligament. In each the presence and position of normal and accessory bile ducts, normal and aberrant right hepatic and cystic arteries were given special attention.

DISSECTION OF THE CYSTOHEPATIC ANGLE

The anterior margin of the right lobe of the liver was elevated and the colon, duodenum and stomach were retracted to expose the gallbladder and the free margin of the gastrohepatic ligament containing the vascular and duct components of the hepatic pedicle. Manual exploration of the epiploic foramen or palpation of the duct system for lesions or stones usually done at this time was postponed until later because of the distortion produced by such manipulations in fixed cadaver material. Slight traction was made on the neck of the gallbladder and the cystic duct was identified within the cystohepatic fold of peritoneum. The hepatoduodenal ligament was opened by a vertical incision through the peritoneum over the common bile and hepatic ducts. The peritoneum was then gently lifted away from the structures in the cystohepatic angle and these were carefully identified, measured and sketched.

In the cystohepatic angle a remarkable number of structures prone to injury from clamping

or the injudicious use of a hemostat around or near the cystic duct are encountered. Judging from the tissue grasp of an ordinary operating room hemostat soft tissues within a radius of 15 mm. from the cystic duct may be accidentally traumatized or included during its ligation and division. Thus twice this radius or 30 mm., a zone the size of a half dollar, located in the cystohepatic angle could contain structures especially liable to surgical injury. To remain, however, as close as possible to the gallbladder and the site of conservative primary surgical division of the cystic duct this 30 mm. zone does not always include the actual junction of the cystic with the common hepatic duct lumen. In cases of a parallel or spiral course of the cystic duct proximal to its junction with the common hepatic duct this zone includes the proximal more horizontal portion of the cystic duct inferolaterally and the right half of the common hepatic duct medially. (Fig. 1.)

Structures Found within the 30 mm. Zone. Employing the exposure described careful dissection of the structures within the cystohepatic angle was made. Only sufficient areolar tissue and fat were removed to insure positive surgical identification of the duct and vascular structures without disturbing their anatomic relationships. For verification their position was compared to the preliminary sketches made before dissection. A rectangular section of glass with a 30 mm. circular zone etched thereon was placed over the cystohepatic angle, with the half dollar size area orientated over the cystic and common hepatic ducts as previously described. The course, position and relations of the cystic artery, right and aberrant right hepatic arteries and accessory bile ducts to this zone were carefully sketched and recorded.

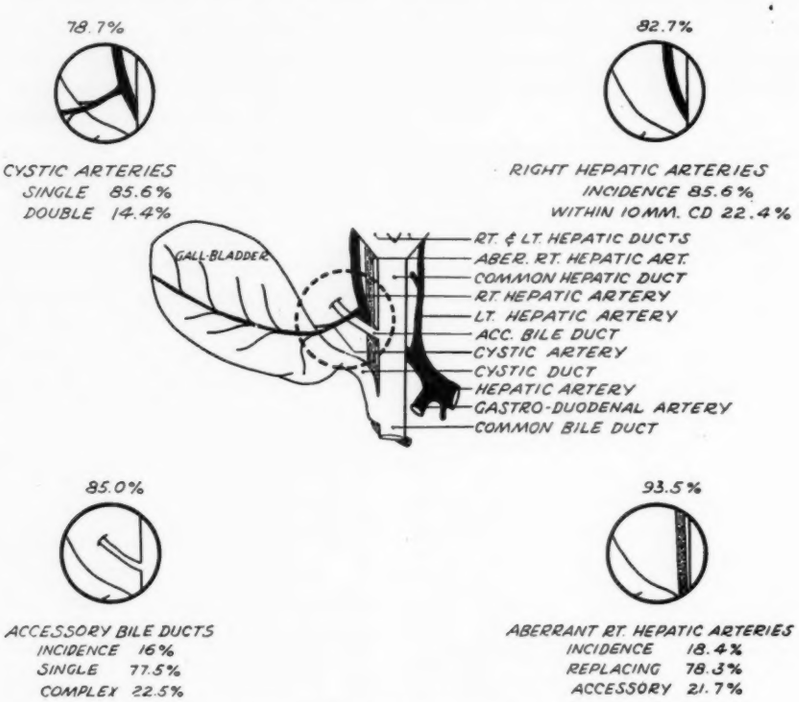


FIG. 1. Structures found within the 30 mm. zone; CD = cystic duct.

Accessory bile ducts: In the course of this study forty accessory bile ducts were found, an incidence of 16 per cent. (Fig 2C and 2D.) Thirty-one were single ducts while nine were complex, exhibiting either multiple or branching patterns. Thirty-four or 85 per cent of these accessory bile ducts were found coursing through the 30 mm. zone previously defined. The remaining six or 15 per cent not observed therein included three cases of multiple small ducts which arose from the liver and drained into the body of the gallbladder, one case of a single duct entering the right hepatic duct and one of a duct complex joining the liver with the gallbladder and right hepatic duct high in the gallbladder fossa. The remaining case was unusual in that the accessory duct arose from the

caudate lobe of the liver and united with the common hepatic duct. The average collapsed diameter of the single ducts measured 2.6 mm. These are small enough to be overlooked yet large enough if divided to produce an insidious leakage of bile into the peritoneal cavity.

then at its right margin entered the 30 mm. zone and coursed vertically behind the cystic duct to reach the right lobe of the liver. In such a position they are especially vulnerable to inclusion by a clamp applied to the cystic duct. Although it is true that ligation of an accessory

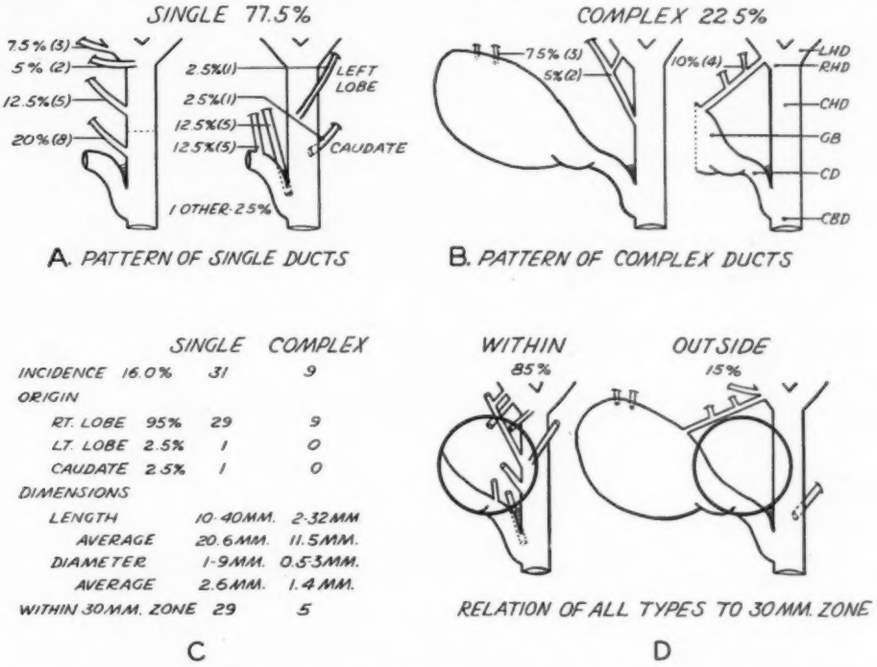


FIG. 2. Accessory bile ducts. LHD = left hepatic duct; RHD = right hepatic duct; CHD = common hepatic duct; GB = gallbladder; CD = cystic duct; CBD = common bile duct.

Normal right hepatic arteries: A normal right hepatic artery arising from the common hepatic derived from the celiac axis was observed in 214 cases or 85.6 per cent. (Fig. 3B.) Of these right hepatic arteries 177 or 82.7 per cent of the total number were observed passing through this 30 mm. zone. Forty-eight or 22.4 per cent were found within 10 mm. of the course of the cystic duct. Thus one of five right hepatic arteries are in danger of inadvertent injury or ligation, with vascular changes in a portion of the right lobe of the liver a probable sequela.

Aberrant right hepatic arteries: Forty-six, 18.4 per cent, aberrant right hepatic arteries were found. (Fig. 3C and 3D.) Of these thirty-six or 78.3 per cent, were replacing vessels whereas ten or 21.7 per cent were accessory to a normal artery. Forty-three of the forty-six or 93.5 per cent of the aberrant right hepatic arteries were observed within the 30 mm. zone. Typically these aberrant vessels reached the liver by passing dorsal to the common bile duct and right hepatic artery is less likely to be followed with vascular changes in the liver than from a replacing one, the preponderance of replacing to accessory of approximately three to one makes accidental ligation of an aberrant right hepatic artery a definite surgical hazard.

Cystic arteries: A single cystic artery was found in 85.6 per cent whereas doubling occurred in 14.4 per cent of the cases. (Fig. 4B and 4C.) It was interesting to note that 225 or 78.7 per cent of the 286 cystic arteries were observed either arising within or coursing through some part of this 30 mm. zone. This indicates that four of five of the cystic arteries sought for ligation during cholecystectomy can be located in this area.

Comments. Employing the approach and dissection of the hepatic pedicle described a high percentage of the structures sought for or to be avoided during cholecystectomy and supraduodenal choledochostomy were located in the region of the cystohepatic angle, more

specifically in a zone 30 mm. in diameter. Seventy-nine per cent of the cystic arteries, 82.7 per cent of the right hepatic arteries, 85 per cent of the accessory bile ducts and 93.5 per cent of the aberrant right hepatic arteries were found to lie within or to course through a part of this half dollar size area. (Fig. 1.)

cases in which the gallbladder did not fill due to cystic duct obstruction direct injection was made into the gallbladder fundus. In this manner the accessory ducts were verified and the unusually small ones were delineated. The

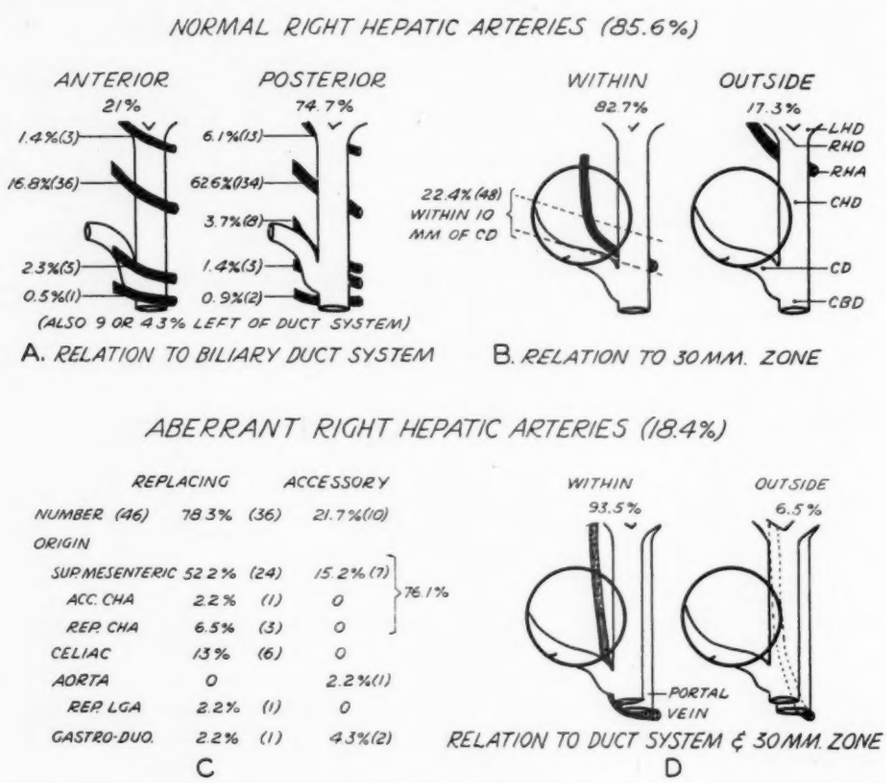


FIG. 3. LHD = left hepatic duct; RHD = right hepatic duct; CHD = common hepatic duct; CD = cystic duct; CBD = common bile duct; CHA = common hepatic artery; LGA = left gastric artery.

ANATOMIC DISSECTION OF THE HEPATIC PEDICLE

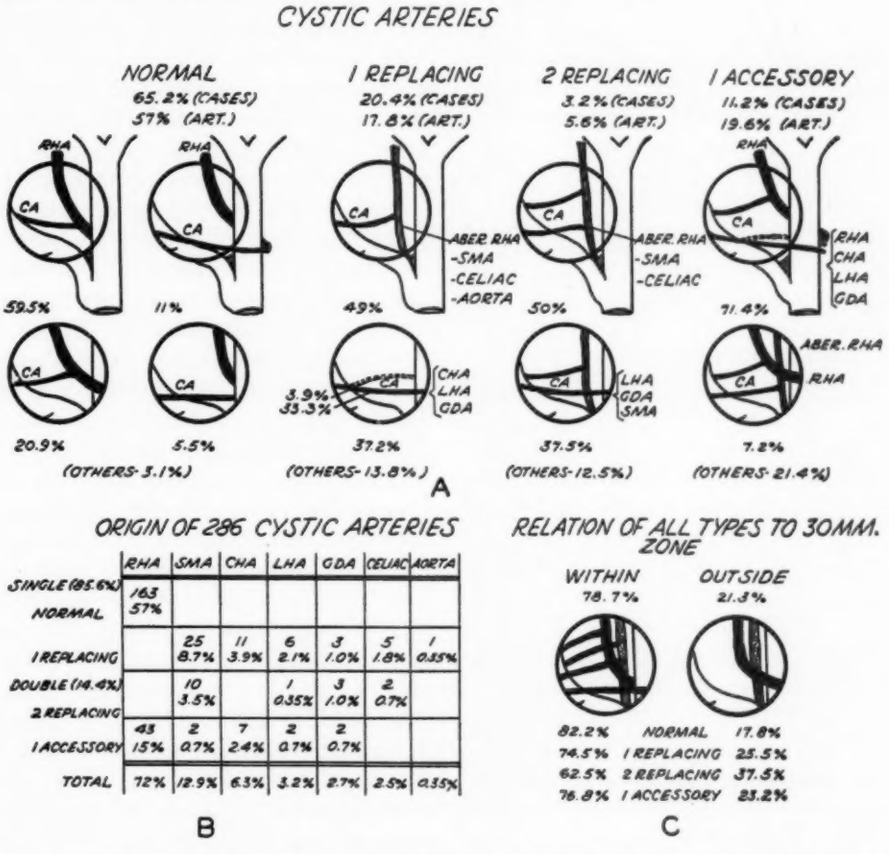
The hepatic pedicle, along with the hepatoduodenal ligament and celiac axis, was completely dissected. The origin and complete course of the normal and aberrant ducts and vessels previously seen were visualized and attention was given to the manner of junction of the cystic with the common hepatic duct. It is apparent that this is a more extensive procedure than would be surgically feasible.

Retrograde injection of an aqueous suspension of ultramarine blue was made under constant pressure into the common bile duct in order to visualize all the accessory ducts, gallbladder and the biliary duct system. In those arterial vascular system of all the cadavers studied had been previously injected with red lead by way of the femoral artery during preparation for laboratory study.

Gallbladder. The gallbladder and biliary duct system were carefully inspected and palpated for stones, obstruction or gross pathologic lesions. The smallest gallbladder found had a measured capacity of 18 cc. whereas the largest contained almost 5 ounces (145 cc.). Neither exhibited gross evidence of cholecystitis or obstruction. No case of congenital absence, intrahepatic, double or bilobed gallbladder or one attached to a separate mesentery was found. The comparative infrequency of such variations has been reported by Moynihan,[31,32] Schachner,[35] Mentzer,[30] Boyden[5] and Gross.[22] The latter found only twenty-eight cases of double, six of bilobed and five of intrahepatic gallbladder

reported in the literature. Latimer and his associates[28] reported three surgical cases of congenital absence of the gallbladder in addition to seventy-one cases collected from the literature. Wendel[40] in 1898 first reported a case of torsion of a gallbladder suspended by a mesentery. Short and Paul[36] have since reported fifty-three cases of torsion of the gallbladder in the literature.

Cystic Duct. The average dimensions of the cystic duct were 30.5 mm. in length and 4.3 mm. in collapsed diameter. The shortest duct encountered was only 4 mm. in length, the longest 65 mm., while the diameter ranged between 3 and 9 mm.



	RHA	SMA	CHA	LHA	GDA	CELIAC	AORTA
SINGLE (85.6%) NORMAL	163 57%						
1 REPLACING		25 8.7%	11 3.9%	6 2.1%	3 1.0%	5 1.8%	1 0.35%
DOUBLE (14.4%) 2 REPLACING		10 3.5%		1 0.35%	3 1.0%	2 0.7%	
1 ACCESSORY	43 15%	2 0.7%	7 2.4%	2 0.7%	2 0.7%		
TOTAL	72%	12.9%	6.3%	3.2%	2.7%	2.5%	0.35%

FIG. 4. RHA = right hepatic artery; CA = cystic artery; SMA = superior mesenteric artery; CHA = common hepatic artery; LHA = left hepatic artery; GDA = gastroduodenal artery.

Gross evidence of gallbladder disease was observed in forty-nine cases (19.6 per cent). Eighteen patients or 7.2 per cent had either adhesions to adjacent viscera or gross thickening of the wall without stones. Cholelithiasis was observed in thirty-one or 12.4 per cent of the cases. Of these four exhibited solitary stones, ten were associated with choledocholithiasis and two with carcinoma of the gallbladder and extension metastasis into the liver parenchyma. Microscopic examination of this material was not practicable because of the loss of histologic detail in routine gross dissection cadaver material.

The pattern of junction of the cystic with the common hepatic to form the common bile duct is summarized in Table 1. The normal angular junction, classically described in the textbooks, of the cystic duct joining the right side of the common hepatic at an acute angle either above or at the level of the first part of the duodenum was found in 68 per cent of the cases. In an additional 10.8 per cent this angular junction was observed with the anterior or posterior aspect of the common hepatic duct (4 per cent anterior and 6.8 per cent posterior). The remaining types were either parallel or spiral before union. A total short parallel course was found in 15.2 per cent, long parallel in 4.4 per cent, anterior spiral in 0.4 per cent and posterior spiral in 1.2 per cent of the cases. In

order to obviate any confusion in the interpretation of the latter types of union the following classification was employed: Short parallel junction designates a cystic duct coursing parallel and bound to the common hepatic duct by fibrous connective tissue for a distance

TABLE 1
JUNCTION OF CYSTIC WITH COMMON HEPATIC DUCT

	Cases	Per cent
Right side of common hepatic duct (Total)	199	79.6
Normal angle	170	68.0
Parallel course	29	11.6
Short parallel	22	8.8
Long parallel	7	2.8
Anterior or posterior aspect of common hepatic duct (Total)	47	18.8
Anterior junction	12	4.8
Angular	10	4.0
Short parallel	2	0.8
Long parallel	0	0.0
Posterior junction	35	14.0
Angular	17	6.8
Short parallel	14	5.6
Long parallel	4	1.6
Left side of common hepatic duct (Total)	4	1.6
Anterior spiral	1	0.4
Posterior spiral	3	1.2

68.0% angular junction with right side of common hepatic duct
10.8% angular junction with anterior or posterior aspect of common hepatic duct
15.2% total short parallel course
4.4% total long parallel course
0.4% anterior spiral course
1.2% posterior spiral course

of 10 to 25 mm. whereas in a long parallel junction this distance was more than 25 mm. It was found that a sheath of connective tissue may bind these ducts so intimately together as to give the outward appearance of a high union whereas the actual junction of the lumen is much farther distally. In spiral junction the cystic duct passed either anterior or posterior to the common hepatic duct before joining the left side of the latter. This deceptive union of the cystic with the common hepatic duct after a parallel or spiral course was strikingly apparent during the retrograde injection of the biliary duct system via the common bile duct. Not infrequently a site well below the apparent junction of the ducts was selected for injection into what was thought to be a normal-sized common bile duct only to find that the injection was passing into the terminal portion of the common hepatic duct enclosed in a connective tissue sheath with the distal portion of the cystic duct.

Ruge[34] presented one of the earlier accounts on the variation of the cystic duct junction. The somewhat widely varied incidences of parallel and spiral courses reported by Eisendrath,[15,16] Ruge,[34] Kunze,[25] Lurje[29] and Beaver[1] were undoubtedly due to their individual and complex classifications of what constituted long or short parallel and spiral junctions. Campiche[10] has reported an unusual case of a cystic duct which coursed anterior to the duodenum and then turned in under the first part of the duodenum to join the common hepatic duct.

Accessory Bile Ducts. Forty accessory bile ducts were found, an incidence of 16 per cent. Thirty-one (77.5 per cent) were single whereas nine (22.5 per cent) were complex in nature. The patterns of the ducts are summarized in Fig. 2A, 2B and 2C. One unusual accessory duct (not illustrated) was found joining the neck of the gallbladder with the left hepatic duct in a case of a low junction of the right and left hepatic with the cystic duct, with a resulting absence of the common hepatic duct. The pattern of the complex accessory ducts was more obscure. Three specimens exhibited multiple short cholecystohepatic ducts between the nonperitoneal portion of the gallbladder and the liver. Two had a single duct leaving the right lobe of the liver which divided, with one branch entering the right hepatic duct and the other the common hepatic duct. Four others exhibited a complicated pattern of an accessory duct connecting the gallbladder with the right hepatic duct, with short side branches entering the right lobe of the liver. These accessory ducts, both single and complex, arose from the right lobe of the liver in 95 per cent (thirty-eight cases), in one case (2.5 per cent) from the left lobe and in another (2.5 per cent) from the caudate lobe. The course and the occurrence of the duct from the caudate lobe was unusual. The duct measured 34 by 3 mm. and arose from the caudate lobe behind the portal vein and then coursed ventral and to the right over the portal vein and entered the left margin of the common hepatic duct 16 mm. above its junction with the cystic duct. No similar case was found in the literature reviewed.

The length and diameter of the accessory ducts were extremely variable. The longest measured 40 mm. in length whereas the largest diameter encountered in another was 9 mm. The dimensions of the single ducts varied from 10 to 40 mm. in length (average 20.6 mm.) and 1 to 9 mm. in diameter (average 2.6 mm.). In the complex pattern group the cholecystohepatic ducts measured 2 to 4 mm. in length and 0.5 to 1 mm. in diameter whereas in the six other cases the major branches measured 8 to 32 mm. in length and the shorter side branches 2 to 9 mm. The average size of the complex ducts was 11.5 mm. in length and 1.4 mm. in diameter.

The incidence of 16 per cent accessory bile ducts in this series of cases compares with Osler and Dow's[33] 20 per cent and Flint's[19,20] 14.5 per cent, but is considerably more than Beaver's[4] 8.7 per cent (five in fifty-seven specimens), Mentzer's[30] 8.3 per cent (eight in ninety-six specimens), Grant's[21] 6.3 per cent (six in ninety-five specimens), Thompson's[37] 6 per cent and Daseler's[13] 2.4 per cent. Boyden has reported an unusual case of hepaticoduodenal duct and an excellent historic review of other unusual duct patterns.

Right Hepatic Artery. A normal right hepatic artery arising from the common hepatic derived from the celiac axis was found in 85.6 per cent (214 of the 250 cadavers). In ten cases it was augmented by an accessory right hepatic artery arising from some other source. The course and relations of the right hepatic artery to the biliary duct system in these 214 specimens is summarized in Figure 3A. It passed anterior to the duct system in 21 per cent (forty-five cases) posterior in 74.7 per cent (160 cases) and remained to the left thereof in 4.3 per cent (nine cases).

The right hepatic artery was found to be closely related or parallel to the course of the cystic duct in 22.4 per cent and was therefore in a position of danger from accidental injury or ligation. In these forty-eight cases twenty-nine coursed within 10 mm. above and closely parallel to the cystic duct whereas the remaining nineteen were closely related to the cystic and common hepatic duct junction. (Fig. 3A and 3B.)

Browne[9] reported an incidence of normal right hepatic artery in 79.7 per cent, Daseler[13] 83.2 per cent, Lander[27] and Flint[19] 84 per cent, Adachi[1] 88 per cent and Thompson[37] 90 per cent. Lander found that the right hepatic artery coursed dorsal to the common hepatic duct in 56 per cent, Daseler 65 per cent, Flint 68 per cent and Thompson 78 per cent. Browne found it to parallel the cystic duct closely in 15.7 per cent.

Aberrant Right Hepatic Arteries. By definition a "normal" right hepatic artery arises from the common hepatic artery derived from the celiac axis. An aberrant right hepatic artery arises elsewhere than from the common hepatic. If the normal right hepatic is also present, the aberrant vessel is termed "accessory"; and if the normal right hepatic is absent, the aberrant vessel is termed "replacing." This terminology, employed by Thompson[37] and others,[9,13] will be utilized in the present paper.

Forty-six aberrant right hepatic arteries were found, an incidence of 18.4 per cent. Thirty-six (78.3 per cent) were of the replacing type whereas ten (21.7 per cent) were accessory vessels. The origin of the aberrant arteries is summarized in Figure 3C. The superior mesenteric artery was the source of 76 per cent of the aberrant right hepatic arteries or 14 per cent of the arteries supplying the right lobe of the liver.

The course of the aberrant vessels was fairly characteristic. When these aberrant vessels were encountered, the hepatic artery proper was usually smaller than normal. The aberrant vessel passed dorsal to the portal vein (except in two cases) and then coursed upward in the margin of the hepatoduodenal ligament to the right of the upper portion of the common bile duct. It entered the cystohepatic angle behind the cystic duct and passed to the right of the common hepatic duct to reach the liver. The exception to this usual course was found in three cases. In these cases the aberrant vessels remained dorsal to the common hepatic duct in their entire course to the liver and thus were not seen in either the cystohepatic angle or the 30 mm. zone previously described. (Fig. 3D.)

Other investigators have reported the incidence of aberrant right hepatic arteries as follows: Adachi,[1] 11 per cent; Brewer[7,8] and Kosinski,[24] 16 per cent; Browne,[9] 20.3 per cent; Lander,[27] 22 per cent; and Daseler,[13] 24 per cent. Thompson[37] estimates that they occur in 12 to 14 per cent of the cases with the ratio of replacing 78 ±4 per cent to accessory 22 ±4 per cent.

Cystic Arteries. Single cystic arteries were encountered in 214 cases of 85.6 per cent whereas doubling occurred in thirty-six or 14.4 per cent. Of the total 286 cystic arteries found single arteries represented 74.8 per cent and double arteries 25.2 per cent.

per cent; anterior to the common bile duct in 2.4 per cent and posterior in 1 per cent; right and below the cystic duct in 2.4 per cent; and near the right and left hepatic duct junction in 1.4 per cent. (Table III.) This should be of practical importance in locating the cystic artery.

TABLE II
ORIGIN OF CYSTIC ARTERIES

	Cases 250	Arteries 286	RHA	CHA	LHA	GDA	Superior Mesenteric					Celiac	Aorta	GDA
							SMA	aRHA	rRHA	rRHA rCHA	aRHA aCHA	rRHA	rRHA rLGA	rRHA
Single:	214	214												
	85.6%	74.8%												
Normal.....	163	163	163											
	65.2%	57.0%	57.0%											
One replacing...	51	51		11	6	2	1	3	17	3	1	5	1	1
	20.4%	17.8%		3.9%	2.1%	0.7%	0.35%	1.0%	5.9%	1.0%	0.35%	1.8%	0.35%	0.35%
Double:	36	72												
	14.4%	25.2%												
Two replacing...	8	16			1	3	1		9			2		
	3.2%	5.6%			0.35%	1.0%	0.35%		3.2%			0.7%		
One accessory...	28	56	43	7	2	2		2						
	11.2%	19.6%	15.0%	2.4%	0.7%	0.7%		0.7%						
Total	Arteries		206	18	9	7	2	5	26	3	1	7	1	1
	Percentage		72.0	6.3	3.15	2.4	0.7	1.7	9.1	1.0	0.35	2.5	0.35	0.35

a = accessory
r = replacing
RHA = right hepatic artery
CHA = common hepatic artery
LHA = left hepatic artery
GDA = gastroduodenal artery
SMA = superior mesenteric artery
LGA = left gastric artery

Normal single cystic arteries (arising from the right hepatic) were found in 65.2 per cent (163 cases), single replacing in 20.4 per cent (fifty-one cases), double replacing vessels in 3.2 per cent (eight cases) and one accessory artery in 11.2 per cent (twenty-eight cases). The origin of the aforementioned arteries from all sources is systematized in Table II and summarized in Figure 4B.

The cystic artery presented an unusually high degree of variability not only in origin as shown, but also in its course to the gallbladder. Since it is always sought for ligation during cholecystectomy irrespective of its origin, the most practical method of locating the cystic artery would be the relationship of its course to the biliary duct system and the 30 mm. zone previously described. The more common types of these relations are depicted in Figure 4A and 4C. Two-hundred twenty-five or 78.7 per cent of the total 286 cystic arteries were found coursing through this 30 mm. area. The cystic artery from all sources arose to the right of the common hepatic duct in 70.3 per cent; passed from left to right anterior to the common hepatic duct in 17.2 per cent and posterior in 5.3

Comments. Other components of the celiac arterial axis with their respective branches and variations are not within the scope of this report since observations were confined to those closely related to the gallbladder and duct system. Two arteries, however, deserve brief comment, an accessory left hepatic and the gastroduodenal artery.

An aberrant accessory left hepatic artery arising from the left gastric was found in 18.2 per cent (twenty-five in 137 cases). Thompson estimates that they occur in 16 per cent of adults and in much higher percentage (77 ± per cent) in fetuses. In three cases these accessory vessels were so large that there was little doubt but that they supplied the major portion of the arterial blood to the left lobe of the liver although they were accessory to a very small left hepatic artery located in the usual position in the hepatic pedicle. In these cases the accessory left hepatic arose from the left gastric proximal to its turning into the lesser curvature of the stomach, hence they could be spared in a gastric resection provided the left gastric artery were ligated distal to its esophageal-gastric angulation and close to the lesser curvature of

the stomach. If a higher point of ligation of the left gastric artery is desired, a moment's search high in the gastrohepatic ligament near the esophageal-gastric junction would be worth while to determine the presence or absence of a large accessory left hepatic artery. Although no true replacing left hepatic from this source was found, there is little reason to doubt its occasional existence.

The gastroduodenal artery, in addition to its right gastroepiploic branch, gives rise to the important anterior and posteriosuperior pancreaticoduodenal branches which pass downward anterior and posterior to the head of the pancreas more or less parallel to the duodenal margin. These form marginal arcades similar to those seen elsewhere along the intestinal tract, from which small straight terminal vessels pass to the duodenum. The posterosuperior pancreaticoduodenal not only supplies the lower portion of the common bile duct but also may spiral around it, with its straight terminal branches passing dorsal to the duct to reach the duodenum. In a retroduodenal approach to the terminal portion of the common bile duct, after the avascular reflection of the duodenum to the left, troublesome bleeding from these branches may be encountered from manipulation of the common bile duct.

CONCLUSIONS

1. Anomalies of the duct and vascular components of the hepatic pedicle are common.

TABLE III

COURSE OF CYSTIC ARTERIES IN RELATION TO BILIARY DUCT SYSTEM

	Arteries	Right and Left Hepatic		Common Hepatic Duct			Common Hepatic Duct and Cystic		Common Bile Duct and Cystic		Common Bile Duct below Cystic		Right and below Cystic
		Anterior	Posterior	Right	Anterior	Posterior	Anterior	Posterior	Anterior	Posterior	Anterior	Posterior	
Single:													
Normal.....	163	0	4	131	12	8	6	1	0	0	0	0	1
One replacing.	51	0	0	25	11	1	6	1	3	0	0	1	3
Double:													
Two replacing.	16	0	0	10	1	0	1	0	0	0	2	1	1
One accessory.	56	0	0	35	10	2	2	2	0	0	2	1	2
Total.....	286	0	4	201	34	11	15	4	3	0	4	3	7
Percentage.	...	..	1.4	70.3	11.9	3.9	5.3	1.4	1.04	..	1.4	1.04	2.44

70.3% Right of common hepatic duct
17.2% Anterior to common hepatic duct
5.3% Posterior to common hepatic duct
2.4% Anterior to common bile duct
1.0% Posterior to common bile duct
2.4% Right and below cystic duct
1.4% Posterior to right and left hepatic ducts

2. Pathologic changes alter the appearance and position of both normal and anomalous ducts and vessels, which materially increase the danger of their accidental injury at operation.

3. Within the peritoneal fold of the cystohepatic angle is found a number of structures either sought for or to be avoided during cholecystectomy or exploration of the supraduodenal portion of the biliary duct system. Specifically, a zone 30 mm. in diameter (the size of a half dollar) located in this region was found to contain the following: 79 per cent of the cystic arteries, 83 per cent of the right hepatic arteries, 85 per cent of the accessory bile ducts and 93 per cent of the aberrant right hepatic arteries. The entire course of these vessels or accessory bile ducts is not confined to this half dollar size area, but an identifiable portion of these structures is to be found within it.

4. This half dollar size area is surgically important in cholecystectomy during the search

for and ligation of the cystic artery since the right and aberrant right hepatic arteries are here in danger of being accidentally traumatized or ligated, compromising the arterial supply of a portion of the liver.

5. One of five or 22.4 per cent of the normal right hepatic arteries were found within 1 cm. of the course of the cystic duct whereas the aberrant right hepatic vessels course immediately behind it. With the preponderance of replacing to accessory vessels of three to one accidental ligation of an aberrant or normal right hepatic artery may well court disaster in a liver whose reserve is already diminished by a pathologic condition.

6. The incidence of accessory bile ducts is higher than generally reported and a high percentage of the single ducts coursed somewhere through the 30 mm. zone. Their diameter is not inconsequential and bile leakage from an unrecognized divided duct is a distinct possibility.

7. The deceptive union of the cystic with the common hepatic duct, especially after a parallel or spiral course, should be recognized to avoid overlooking a stone lodged in its distal portion and in estimating the actual length of cystic duct remaining after cholecystectomy.

8. Realization of the occurrence and frequency of these anatomic variations should materially reduce the surgical complications based on anatomic aberrations.

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SURGICAL TREATMENT OF FUNNEL STERNUM

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BAUHINUS[1] in 1594 described a method of dealing with funnel sternum and a variety of procedures have been advocated and used. The modern trend in the surgical treatment of this disease was introduced by Meyer in 1911 when he advocated excision of costal cartilages adjacent to the depressed portion of the sternum. This was followed with Sauerbrook's operation in which the depressed costal cartilages and sternum were excised. This had the disadvantage of leaving the viscera of the chest unprotected, development of paradoxic respiration and in some instances herniation through this area. Many articles have appeared by Ochsner and DeBakey,[2] Sweet,[3] Alexander, Ombrédanne, Graham, Nissen[4] and others. Brown[5] went very thoroughly into the theories regarding the etiology and treatment of this deformity.

FIG. 1. Case 1. Photograph of front of chest showing marked depression of sternum.

It has been fairly largely agreed that this is a congenital deformity in which the central tendon of diaphragm and the substernal ligament were shortened in such a way that although the sternum is not pulled in still it is not allowed to expand at this level as it does at a higher level. Surgical treatment advocated by Brown[5] and subsequently by others involves the division of this restraining central tendon of the diaphragm with various methods of excision of cartilages and sternum or division of sternum in such a way that it can be brought forward into a more normal position. It is widely agreed that 75 per cent improvement is a satisfactory result by these forms of treatment. Nissen's[4] method is to remove the portion of sternum and costal cartilages, rotating it through nine degrees on the flat so that it can be propped up on the prominent costal cartilages on each side. This has given good results in his hands. The method of removing the sternum and costal cartilages *en bloc* and reversing the position so that the convex depressed portion is projecting anteriorly has also been used with satisfaction by others.

The purpose of this paper is to describe another method of dealing with this lesion which has yielded better results in my hands.

Everett Graham sounds a warning note regarding the indications for undertaking such operations. It is obvious that varying degrees of this deformity can occur, and in many of them there is no disability and no reason for undertaking surgical treatment. On the other hand, if there is evidence of cardiac or respiratory embarrassment or both, or if the patient is much concerned about the appearance of the deformity, surgical treatment is indicated. These have been the problems present in the patients upon whom I have operated. All of those treated had been referred to me because of cardiac symptoms and proof of this as a source of the symptoms was provided by the patients' relief following operation. It is notable most of the reports of repair operations of this deformity are on small or adolescent children. On the other hand, most of my

FIG. 2. Case 1. X-rays showing depressed sternum

patients have been in early adult life who were either greatly disabled or completely incapacitated from cardiac symptoms.

Although this report is based on the results of five operations of this nature, for the sake of brevity only two representative cases will be reported.

CASE REPORTS

CASE 1. The first patient was a young woman twenty-six years of age sent by a cardiologist who stated that she had been a cardiac invalid for the past three years. There was a systolic murmur over the base of the heart region and the patient was thought to have a rheumatic heart. However, the cardiologist came to the conclusion that there was no intracardiac lesion and that perhaps the whole disability resulted from the displacement of the heart and mediastinal structures by the greatly depressed sternum.

X-rays (Fig. 1) showed a typical funnel sternum with depression of the gladiolus and ensiform approaching in the lateral x-ray within 1¼ inches of the vertebral column. Clinically the patient had very great deformity of the front of her chest with a round-shouldered posture. As well as the marked dyspnea made worse by exertion, she was much disturbed by her personal appearance. (Fig. 2.)

At operation under positive ventilation anesthesia a midline incision was made from the junction of the manubrium and gladiolus to a point 2½ inches below the ensiform cartilage. It was obvious in this particular case that although there was depression of the lower end of the sternum there was also some deformity extending up and involving the manubrium. It was thought, therefore, that an attempt should be made to correct the sternum throughout its whole length. The ensiform cartilage and sternum were split with bone forceps up the midline through the gladiolus and manubrium. The two halves of the sternum with their costal cartilages were elevated; and as this was done, the dense central tendon of diaphragm and other retaining structures on the deeper aspect were divided until the sternum and cartilages could be drawn well up to a normal level. In spite of this, however, there was a strong springing action of the costal cartilages and ribs tending to replace the sternum to its former position. To prevent this the cartilages and ribs were divided at two points lateral to the sternum on each side, from the second rib down to and involving the structures at the costal margin. The ribs were divided lateral to the sternum at the point of maximal anterior curvature allowing these structures to straighten out and run medially in an appropriate direction. However, with the extreme convexity posteriorly near the sternum this improvement in position caused a very great eversion of that half of the sternum

3 4

FIG. 3. Case 1. X-ray showing elevation of sternum and fixation by stainless steel wires.
FIG. 4. Same case. Photograph of front of chest after elevation of sternum showing improved contour of front of chest.

involved. Therefore, a second incision was made through these structures closer to the sternum so that the ribs and costal cartilages could be rearranged in a fashion so as to restore to normal their curves and contours. This was carried out on both right and left sides. Both pleural cavities were opened to accomplish this, but with the positive ventilation anesthesia there was no difficulty experienced on this account. The ribs and cartilages were divided from within the pleural cavities with bone-cutting forceps. With heavy forceps the deformities and curvatures of the sternum and adjacent structures were bent and warped in such a way as to restore their contour to normal. Four stainless steel wires, No. 28, were passed beneath the two halves of sternum and brought out through the skin on each side. The halves of the sternum were next sutured together with wire and the subcutaneous tissues and skin closed after aspirating air and fluid from both pleural cavities, thereby fully expanding both lungs. At the conclusion of this stage all anxiety of the anesthetist regarding the open pleurae was relieved. The plan then was to suspend the sternum and these mobile costal cartilages and anterior ends of ribs in such a way that they would hold a normal position until they had united solidly and would retain their position. The principle of Jacob's ladder, as suggested by Brown, was applied but more extensive support was necessary to prevent paradoxic respiration and retraction. It was necessary to have the support countering the pull of these loose fragments resting securely on the firm portions of the bodies of the ribs lateral to the sites of the most lateral incisions. The most satisfactory object for this support was a cake tin of which there are many sizes; the appropriate one can be selected according to the size and stature of each patient. Through the bottom of this cake tin multiple holes were made through which the wires could be threaded, and windows were made in each side and in each end through which one could work easily with the wires so that they could be projected up through the holes in the bottom when the tin was inverted over the chest wall. With suitable traction on these

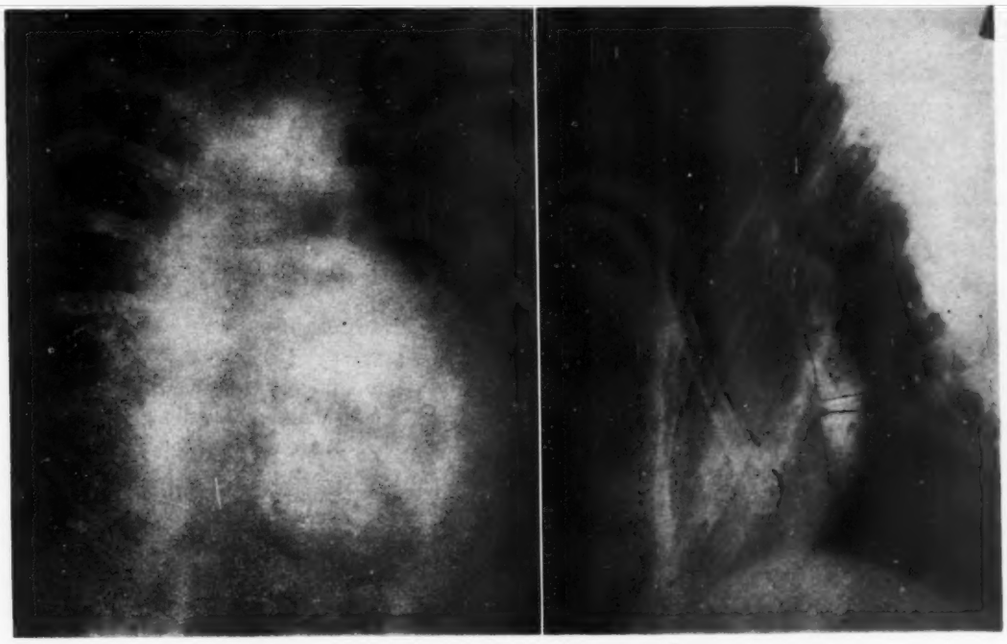

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FIG. 5. Case II. Showing gross displacement of heart to left.
FIG. 6. Same case. Showing great depression of lower end of sternum.

wires the appropriate level of the front of the chest and sternum was easily seen through the windows, and by tying the ends of each pair of wires over the bottom of the cake tin the structures were stabilized in good position. Suitable padding was placed beneath the rounded edges of the cake tin on each side of the chest wall and light packing applied in the spaces between the wires as a gauze dressing.

Other wires were passed through the windows in the cake tin and brought out superficially; to these a traction rope and weight suspended from an overhead beam were applied to relieve the patient of some of the pressure on the anterior chest wall from the strong pull during inspiration. When so arranged the patient could cough and do deep breathing with relatively little discomfort. After a period of ten days to two weeks the patients were sufficiently comfortable so that they could discard the overhead pull and were out of bed walking about comfortably with this apparatus on their chests. It was kept in position for not less than six weeks and in one case for eight weeks. At that time it was found that the wires were relatively slack in their positions; on removal of the support and the wires the sternum and chest wall stayed in position without any tendency toward retraction or recurrence of the deformity. This patient improved very remarkably after her operation, and from being a semi-bed invalid she has returned to work and athletics. She is highly pleased with the normal shape and appearance of her chest and is a most grateful patient.

FIG. 7. Case II. Showing elevation of sternum and fixation by steel wires to external support.

Figure 3 shows the application of this external traction support. Figure 4 shows the lateral x-ray with the apparatus applied showing a satisfactory level of sternum.

CASE II. The second patient was a young woman aged twenty who was sent by her cardiologist because of severe cardiac disability. She was a semi-bed invalid and was unable to do work of any sort. Her x-rays showed the heart completely in the left chest cavity. The sternum was within ¾ inch of the vertebral column on lateral x-rays. This was complicated by a fairly marked scoliosis. She also was mentally depressed because of the extreme deformity of her chest. (Figs. 5 and 6.)

Operation was decided upon because of the severity of the deformity and the patient's aversion to this and because of the extreme cardiac disability.

The operation was similar to that described in the previous case except the manubrium in this patient did not seem to be involved in the deformity. For that reason the sternum was divided completely across just above the angle of Louis and then split longitudinally from that level distally including the ensiform. Otherwise it was dealt with in a fashion similar to that already described. This patient, also, has made an excellent recovery, has returned to active life, is taking part in some sports and is immensely pleased with the normal appearance of her anterior chest wall. (Fig. 7.)

SUMMARY

A method of surgical treatment for depressed sternum has been described in which after appropriate division of costal cartilages and ribs in suitable places, remodelling of the front of the chest wall including these structures and the sternum has been carried out giving a satisfactory cosmetic result with no tendency toward recurrence and with relief of symptoms resulting from visceral embarrassment from depressed sternum.

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RELATION OF HORMONES TO FEMALE GENITAL CANCER

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FOR many years endocrinology has been one of the focal points in cancer research. Most of this interest has centered about the steroid hormones, particularly the estrogenic hormones of the ovary. It is true that other endocrine glands like the anterior pituitary gland have at times been suspected of complicity in cancerogenesis but it is the estrogens which have been the chief target of suspicion, certainly as related to genital and mammary cancer. Even before the isolation of the ovarian hormones a good deal of experimental investigation was done to suggest a possible influence of the ovarian secretion upon the development of mammary carcinoma. Some of these early studies, based on the effects of the impure ovarian extracts of one sort or another which were then available or upon ablation experiments, yielded at least a modicum of results which still remain valid.

This would apply certainly to the work of Leo Loeb whose experiments on mice led him to conclude that the ovarian hormone can play a part in the development and growth of cancer in those organs and tissues which are normally under the physiologic control of the ovaries, which means the genital tract and the mammary glands. This observation was published as far back as 1918, but who will deny its validity even today? It lies at the very core of the far flung studies which have been made since then on the role of estrogens in the production of cancer. It is the breast and the genital tract which are the target organs in such studies and not such organs as the stomach or lungs, which one does not associate with estrogen control.

The first clear-cut demonstration of the carcinogenic effect of estrogens came in 1932 when Lacassagne was able to produce cancer in the mammary glands of male mice of a strain the females of which (but not the males) were susceptible to mammary cancer. This qualification is of profound significance for it runs like a constantly recurring theme through all subsequent studies in the same field. Lacassagne's experiments themselves have been confirmed by all who have repeated them.

The other point in Lacassagne's experiments which deserves emphasis is that the total dosage employed to produce cancer was extremely large, chiefly because of the long periods of time during which it was necessary to keep up the estrogen administration. Practically all subsequent investigators have likewise emphasized that it is the prolonged exposure to estrogen administration rather than even a very large dosage kept up for short periods which may tend to the development of cancer. Such an observation as this may even have an application to the clinical employment of estrogens.

Since the work of Lacassagne there has been an enormous amount of experimental study, chiefly in mice, rats and monkeys, in an effort to determine the importance of the estrogens in the production and growth of mammary and genital cancer. The interested reader will find available a number of excellent reviews of this whole question, like that of Gardner.[1]

Although it has been shown that in mice and rats estrogens can incite the development of mammary cancer, at least in animals of a cancer susceptible strain, the results of similar experiments in monkeys are more difficult to crystallize, and the lesions of the breast produced in this animal appear usually to be histologically cancer-like rather than genuine clinical cancer in the sense that they produce metastasis and death. Rather curiously, in view of the fact that it is the uterus which is physiologically the chief estrogen receptor organ, it has not been possible, so far as I know, to produce endometrial carcinoma by means of estrogens. Benign hyperplasia can be brought about but continuance of the dosage, in the rodents at least, tends to bring about an aseptic form of endometrial necrosis and sometimes pyometra. On the other hand, genuine carcinoma of the cervix has been produced in mice by Gardner and Li as well as others. Again it is emphasized that very prolonged

dosage, often two years or more, is required to produce the malignant lesion in the cervix.

These statements may seem surprising in view of the reports of at least a small group of human cases in which endometrial carcinoma followed estrogen therapy, which by inference might have been the inciting factor. In evaluating such cases two important considerations must always be kept in mind. One of these, of course, is the *post boc propter boc* factor since endometrial cancer has developed in innumerable women who have had no estrogen therapy and cancer has not developed in innumerable women who have had prolonged estrogen therapy. The same consideration must be kept in mind as regards the very small group of reported human cases in which cancer of the breast has been attributed to estrogen therapy. The other important consideration bears on the pathologic interpretation of the uterine or breast lesions in question and as to whether or not they are only cancer-like but not actually cancer. In the case of the endometrium, for example, I do not believe that any pathologist in the world can with absolute certainty differentiate between certain highly atypical adenomatous, proliferative but benign hyperplasias and genuine adenocarcinoma.

The fact remains, however, that there is good reason to believe that prolonged exposure of the endometrium to estrogens, whether produced in the body or administered therapeutically, may play at least a predisposing part in the development of carcinoma in a woman possessed of the unknown and still very intangible genetic predisposition to the disease. This is suggested by the fact that postmenopausal production of estrogen presumably by the adrenal cortex and not infrequently expressed by endometrial hyperplasia is not uncommon in uteri, the seat of endometrial carcinoma.

Throughout reproductive life the endometrium is under the influence of estrogens, but in an interrupted fashion, with a monthly sweeping-off and a counteracting and apparently protective effect from progesterone which thus far seems clear of suspicion as a carcinogen. On the other hand, it is not difficult to believe that prolonged exposure of the aging endometrium to even small amounts of estrogen with no interjection of the protective effect of progesterone might well predispose to cancer. The factor of aging, whatever intracellular changes this may imply, must play some predisposing role in the development of cancer, but the frequent occurrence of this disease in young individuals would indicate that it is not all important.

There is still other evidence, such as the apparent influence of the late menopause in the development of endometrial cancer and the fact that at times one can demonstrate in a single endometrium all degrees of histologic steppingstones, namely, estrogen-induced benign hyperplasia, atypical adenomatous hyperplasia and, finally, unquestioned adenocarcinoma.

In pregnancy, characterized as it is by an enormous production of the reproductive hormones, the growth of mammary and also clinical carcinoma is greatly accelerated although it is only fair to say that this might just as well be explained by the factor of increased vascularity of the involved organs as by any direct hormonal effect. On the other hand, we are beginning to appreciate that the pregnant cervix not infrequently exhibits cellular and metaplastic changes readily mistaken for cancer, especially of the intra-epithelial type, and in at least some cases these changes may regress spontaneously after the pregnancy.

Many other facets of this interesting question might be discussed, but even these sketchy observations will suggest that the problem is not a purely academic one and that it has a bearing on clinical problems and practices. There is no question that the clinical employment of the estrogens is still widely abused, that these hormones are often given without the slightest rational justification, especially in the treatment of genuinely or, too often, only supposedly menopausal symptoms. This is not the place to inveigh against these abuses justified though the indictment would be.

From our present standpoint, however, the question arises as to the possible hazard of cancer from excessive or prolonged estrogen therapy. When this is carried out continually for long periods, perhaps many years, as it unfortunately often is in the management of menopausal women, there is reason to believe that a definite hazard exists; histologic studies in at least some cases support this belief. There are other good reasons why continuous estrogen therapy should never be used at the menopause or why for that matter any estrogen should be given in the vast majority of women at this epoch. In a small proportion of women, how-

ever, the severity of vasomotor symptoms fully justifies resort to the interrupted employment of estrogens and under such restrictions there would appear to be no reason for concern.

On the other hand and on the basis of such observations as have been previously mentioned, I believe that one should try to avoid estrogen therapy or at least hold it down to minimum proportions in women with a very strong family history of cancer, those who suffer with any so-called precancerous lesion or those who have previously been treated for cancer whether surgically or radiologically. Even in these cases it is probable that modest and interrupted estrogen administration would impose little or no hazard in the treatment of severe menopausal symptoms. However, most of us would probably prefer to play as safe as possible by resorting to testosterone instead, as this relieves the vasomotor symptoms satisfactorily although probably with less striking effectiveness than estrogen.

Finally it seems somewhat paradoxic in view of what has been said as to the carcinogenic effects of estrogens that a large dosage of these hormones is now employed in the palliative treatment of advanced cancer of the breast and that it is apparently effective in a large proportion of cases although it is my impression that the androgenic hormone is of even greater value. How these hormones bring about their palliative results is not yet clear although it seems probable that these effects are mediated through the pituitary. These therapeutic efforts followed rather naturally the demonstration by Huggins and his co-workers of the palliation of many cases of advanced prostatic cancer by estrogen therapy, especially through the use of synthetic diethylstilbestrol.

Many years ago I heard a distinguished pathologist not given to irresponsible statements say it is not impossible that the closed door of the problem may one day be unlocked by an endocrine key. I suspect that most cancer investigators of the present day would refrain from any very enthusiastic endorsement of such a statement, but there are probably few who do not believe that endocrine research in the cancer field may prove its worth in locating the key which will fit smoothly in the lock.

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PREVESICAL PROSTATECTOMY*

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A METHOD of approach and procedure in extravesical enucleation prostatectomy which avoids the posterior surface of the symphysis pubis and the complexities of the periprostatic veins and which permits easy manipulation in an accessible area of the space of Retzius is prevesical prostatectomy. The fat-covered veins unavoidably torn when reflecting the retropubic fascia from behind the symphysis are not encountered. In such a retropubic approach visualization, clamping, ligation or electrocoagulation of bleeding vessels are often a formidable problem. Contact with the symphysis pubis and paraprostatic recesses is totally avoided and its relationship to osteitis pubis is excluded. The lateral prostatic plexuses of veins are not disturbed by packs. The puboprostatic ligament which lies over the deep dorsal vein of the penis and its bifurcation is not incised. A large portion of the prostatic capsule is not exposed and a low incision in the prostatic capsule is avoided. An interrupted suture, continuous running suture or lock stitch in closure of the prostatic capsule is not used since the direction of the needle in such types of suture is toward the symphysis pubis which can be repeatedly punctured. Exposure, incision and closure of the prostatic capsule are not executed in a deep, hidden and inaccessible confine of the cave of Retzius.

Prevesical prostatectomy specifies an approach to the prostate gland in which the prevesical fat and fascia on the antero-inferior border of the collapsed bladder is initially reflected in the midline from above downward and in which the periprostatic fascia is secondarily approached. There follow a very limited exposure of the prostatic capsule in which a slightly elliptical transverse incision is made ½ cm. distal to the prostatovesical junction incision of the anterior wall of the urethra at the apex of the adenoma with the Satinsky scissor after the adenoma is freed and closure of the prostatic capsule with the right-angled Cushing suture as used for seroserous approximation in intestinal anastomosis. The immediate retropubic or paraprostatic spaces are not disturbed.

The most cautious step in any form of the Millin type retropubic prostatectomy is the approach to and exposure of the prostatic capsule. It is at this time that the vascular topography must be carefully scrutinized. Obscure veins enmeshed in retropubic fat and inadvertently torn during manipulation incident to exposure of the prostatic capsule can cause extremely troublesome bleeding and hemorrhage. Repeated attempts to identify retracted, fat-covered bleeding vessels become time-consuming. I (A. R. F.) saw one surgeon encounter so much bleeding that he was committed to pack the space of Retzius for seventy-two hours. He never approached the prostatic capsule and did a cystotomy. In the patient osteitis pubis developed. The surgeon had deliberately incised the puboprostatic ligament near the symphysis and inadvertently divided the deep dorsal vein of the penis. Retraction of the distal end of this large vein beneath the symphysis made clamping impossible. In the prevesical approach to the prostatic capsule an area is uncovered in which the vessels are easily visualized. These can be clamped and sealed with electrocoagulation under vision. Of paramount importance is the execution of very gentle reflection of prevesical fascia on the bladder wall from above downward with the gauze-covered index finger which must not deviate from the midline until the prostatovesical junction is approached. The reflection of fascia must not begin from or be carried along the symphysial border of the retropubic area and extended to the deep retropubic recess where control of bleeding vessels is accomplished with great difficulty. Exclusive prevesical manipulation on the bladder surface in the approach to the prostatic capsule provides the ideal method of management of blood vessels which are evaded or handled under vision.

The puboprostatic ligament usually blends into the visceral endopelvic fasica of the pros-

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tate around which lie the periprostatic veins. It is permissible to incise the ligament only in the region of the superior border of the prostate if the ligament extends to the bladder. This same incision may be extended and deepened for the prostatic capsule. Retraction of the distal flap of the incised prostatic capsule toward the pubis as a result of the ligament is prevented by the initial ligature stay suture previously applied just distal to the proposed site of the transverse incision in the prostatic capsule.

The variations of the periprostatic venous pattern are too great to permit adoption of any one method of management of these veins. One or more transverse ligatures through the false capsule of the prostate should be used just distal to the proposed line of incision in the prostatic capsule. A significant advantage in prevesical manipulation is the fact that the variations of vascular topography overlying the prostate are observable and the difficulties arising from there are always manageable.

A high incision in the prostatic capsule is most desirable. Such an incision remains proximal to the bifurcating branches of the deep dorsal vein of the penis and also permits easy closure of the incised capsule. A slightly elliptical transverse incision with the concavity toward the bladder side will favor cephalad tearing of the capsule upon enucleation of large adenomas, if tearing occurs, and evasion of the bifurcating branches of the deep dorsal vein of the penis and the lateral prostatic venous plexuses. Very large adenomas are best delivered in lobes. In cases of intravesical, horse-collar prostatic adenomas the prostatovesical junction is palpable more cephalad than the intraurethral prostatic enlargement. In such cases the transverse incision may encounter the bladder cavity rather than the adenoma. It is therefore advisable to make the transverse incision in the prostatic capsule about 1 cm. in length in the midline initially and introduce the little finger in the incision to determine whether the adenoma is encountered outside the bladder cavity, if the adenoma is not readily visible or whether the bladder cavity is entered. Should the latter occur it is a simple matter to close the defect with a suture or two and make a new incision slightly lower. The usual arterial bleeding vessels met upon incision of the capsule are promptly clamped and electrocoagulation current applied.

The adenoma is enucleated slowly and gently without undue stretching of the capsule. The use of the Satinsky scissor provides exceptional ease with which to incise the urethra at the apex of the adenoma and prevents the capsular tearing often incurred as a result of splitting the urethra digitally.

The continuous right-angled Cushing suture permits the direction of the line of suture parallel to the posterior surface of the symphysis, and the needle is at no time directed toward the pubis which could otherwise be inadvertently punctured repeatedly. This suture is valuable in that it produces water-tight closure and requires only forty-eight hours of postoperative catheter drainage. The entire capsular thickening is included in the suture so that hemostasis is secured.

TECHNIC

A midline suprapubic incision beginning at the base of the penis is made with the patient in slight Trendelenberg position. The rectus fascia is incised and the muscle is separated in the midline by blunt dissection. A retractor is placed in the wound.

The prevesical fat and fascia are reflected from above downward very gently on the collapsed bladder. The gauze-covered index finger must not deviate from the midline. The perivesical veins encountered are either avoided or clamped and sealed with coagulation current. The reflection of fascia is carried down to the area of junction of bladder and prostate where a very small area of about 1 cm. in depth and 3 cm in width of prostatic capsule is exposed. Midline periprostatic veins, if present, will tear upon reflection of the small area of periprostatic fascia. These veins are best divided between clamps previously touched with electrocoagulation current in the line of the proposed incision of the prostatic capsule. The periprostatic fascia can then be better reflected if it is necessary to expose further the small area of prostatic capsule.

A midline ligature stay suture is taken about 1 cm. below the prostatovesical line, incorporates the entire thickness of the true and false capsules and undermines the distal cut and coagulated ends of the midline periprostatic veins if present. It is occasionally advisable to place one suture on each side of the midline stay suture. Another midline ligature stay suture is placed about ½ cm. proximal to the

previously placed midline stay suture to provide a stay suture for the upper flap of the incised prostatic capsule. A small full curved needle (No. 14) and chromic No. 1 catgut are used for all capsular sutures.

With suction in readiness a slightly elliptical transverse incision with the concavity toward the bladder side is made between the stay sutures and extended down to the adenoma. The length of the incision varies with the size of the adenoma but a length of 2 cm. is usually ample. Clamping of arterial bleeding vessels is done promptly and coagulation current applied.

The prostatic adenoma is very gently enucleated in the proper plane of cleavage from the apex upward with care not to avulse the mucosa of the membranous urethra and not to tear the prostatic capsule. The anterior wall of the urethra is incised with the Satinsky scissor at the apex of the adenoma. A pack is temporarily placed in the prostatic bed upon removal of the adenoma and active bleeding is attended to with coagulation current.

The bladder cavity is palpated. The adequacy of the vesical neck is determined. If two fingers do not pass freely through the vesical orifice, a wedge of tissue is resected from the posterior lip of the vesical neck. This is almost always the case. The bladder cavity is suctioned of clots.

A Cushing suture of chromic No. 1 catgut is used for closure of the prostatic capsule over a No. 26 French Foley catheter having a 30 cc. bag capacity and which is passed via the external urethral meatus into the bladder. The Foley bag is inflated with 30 cc. of water and remains in the bladder cavity. The entire capsular thickening is included in the suture.

A Penrose drain is placed in the space of Retzius. Chromic No. 1 catgut is used for muscle and fascia with retention sutures.

POSTOPERATIVE MANAGEMENT

An infusion of glucose and water is given on the day of operation. Penicillin and streptomycin are given for six days. Supplementary carbohydrates, amino acids and iron are administered orally, and vitamin B complex and vitamin C are given by injection.

The catheter is not irrigated unless there is evidence of impaired drainage. The urine may contain blood for twenty-four to forty-eight hours. The patient is allowed out of bed the first postoperative day.

The catheter is removed and the drain shortened after the third day; the skin sutures are removed on the fifth day and the retention sutures are removed on the sixth day at which time the patient may be discharged from the hospital.

RESULTS

In thirty-three cases of prostatectomy utilizing the prevesical approach and technic the enucleated adenomas varied from small to large size. The smallest adenoma was 20 gm. and the largest was 160 gm. Fourteen of these patients were followed up over a period of one year and presented no complications. There was one complication in the entire series of cases. A secondary hemorrhage developed on the fifth postoperative day in a case which was ambulatory and voiding since the second postoperative day. The prostatic bed was packed transvesically and the patient was discharged ten days later. All other cases were discharged from the hospital between the sixth and tenth postoperative day. Eighteen of the patients were discharged on the sixth postoperative day.

SUMMARY

Prevesical prostatectomy specifies a strictly midline, gentle reflection of prevesical fascia on the antero-inferior surface of the collapsed bladder from above downward to the region of the prostatovesical junction where a very limited exposure of the prostatic capsule is made. The retropubic and paraprostatic recesses are not disturbed. Blood vessels are evaded or coagulated. The adenoma is gently enucleated and the urethra is incised at the apex of the adenoma with the Satinsky scissor.

A high slightly elliptical transverse incision is made in the prostatic capsule. The Cushing suture is used in a water-tight and hemostatic closure of the incised prostatic capsule.

This technic presents the following advantages: (1) Bleeding is minimized and hemorrhage is prevented; (2) management of bleeding vessels is easy and prompt; (3) the element of contact with the symphysis pubis and paraprostatic recesses is excluded as a cause in the production of osteitis pubis; (4) the prostatic capsule tears cephalad, if tearing occurs, and the lateral prostatic venous plexuses are evaded; (5) the Satinsky scissor provides facil-

ity in the separation of the urethra at the apex of the adenoma, prevents tearing of the capsule and assures continence; (6) the Cushing suture secures hemostasis and a water-tight closure of the incised prostatic capsule and avoidance of contact with the symphysis pubis; (7) early ambulation, short duration of catheter drainage and hospitalization are provided.

CONCLUSIONS

Prevesical prostatectomy affords an efficient and safe method of suprapubic extravesical enucleation of the prostatic adenomas, a benign postoperative course with a short period of hospitalization and good results.

Cautiousness and gentleness in manipulation are prerequisite in this or any other modification of the Millin type retropubic prostatectomy.

A knowledge of the anatomy of urethrovesical structure and of vascular topography is essential.

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MANCHESTER OPERATION OF COLPORRHAPHY IN THE TREATMENT OF UTERINE PROLAPSE*

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UTERINE prolapse is an old lesion about which much has been written. Among the writings of Hippocrates reference is made to the fact that displacements of the uterus were recognized but it was not until the time of Galen, 130 to 210 A.D., that this condition excited much interest. Galen also well described the condition of prolapsus uteri.

According to William Fletcher Shaw,[1] Marshall Hall of London seems to have been the first to suggest narrowing the vagina in the treatment of uterine prolapse but there is no record that he performed the operation himself.

In 1831 Heming operated upon the anterior vaginal wall and was followed by numerous other surgeons, including Marion Sims, Emmet, Aveling and Gaillard Thomas. Operations on the posterior vaginal wall and perineum were performed by Hegar, Simon, Emmet, Martin and others. The cervix was amputated by Huguier, Coupil, Sims and others.

The 1890 edition of Hart and Barbour contains this statement about perineorrhaphy, "These operations help, at least by enabling the patient to wear a ring pessary," and that apparently was the object for which the operation was performed.

While numerous surgeons performed single operations on the anterior vaginal wall, on the posterior vaginal wall and amputated the cervix, none combined these three operations until some members of the Staff of the Women's Hospital attached to the University of Berlin and A. Donald of Manchester started to do so in 1888. Thus in 1888 A. Donald of Manchester quite independently began to treat cases of prolapsus uteri by the combined operation of anterior and posterior colporrhaphy and amputation of the cervix. Donald's first two operations were performed on April 28 and July 18, 1888, silver wire being used as suture material as this was the most commonly used suture at that time. Hearing that a new absorbable suture material, catgut, was being tried in general surgery in Germany, Donald obtained some of this catgut, sterilized in carbolic oil, and used it in the performance of his third operation on August 3, 1888. He did an anterior colporrhaphy and approximated the deep tissues with a buried continuous suture of catgut. Two weeks later he did a posterior colporrhaphy using the same technic. The patient was discharged on August 30th and the following discharge note was made: "The wound was healed and the outlet of the vagina only admitted two fingers with difficulty, no pessary was inserted." Originally Donald made the denudation of the anterior vaginal wall with a wide diamond-shaped incision; later, W. E. Fothergill modified this by making it triangular in shape, with a wide base near the cervix, and by a circular incision around the cervix he combined the amputation of this organ with the anterior colporrhaphy. The result of this modification was the wider exposure of the tissues of the broad ligaments on each side of the cervix which permitted better and stronger apposition of these structures in front of the cervix.

ROLE OF THE CARDINAL LIGAMENTS IN UTERINE SUPPORT

Numerous anatomic studies have shown that the cardinal ligaments, also known as the ligaments of Mackenrodt, and the parametria play an important role in maintaining the uterus at the proper station in the pelvis. This may be proved in the performance of an abdominal panhysterectomy. If a tenaculum is placed on the uterine fundus and traction exerted upward, the uterus is not raised appreciably when the infundibulopelvic and round ligaments are cut, but practically always it can be raised to the abdominal incision or close to it when the cardinal ligaments are severed. Therefore, if the cardinal ligaments are well developed and

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not too attenuated, it is of considerable advantage to use them when operating for uterine prolapse. In proposing his operation for colporrhaphy Donald understood this principle and followed it.

W. F. Shaw[1] states that since the establishment of this operation by A. Donald in 1888, it was performed upon all patients, irrespective of age, parity and social standing, by the Manchester group of gynecologists and by the staff of St. Mary's Hospital, with the exception of two during the forty-five years that followed. In 549 cases reported by Shaw[1] in the paper that he read before the American Gynecological Society, Washington, D.C., May 8 to 10, 1933, he resorted to an abdominal fixation of the uterus in addition to the Manchester operation on only two patients in this series, and this because of the fact that practically no muscular tissue was found in the pelvic floor. Elsewhere in this same paper he reported having the records of 2,152 women upon whom he had operated by this method during a period of twenty-six years, with nine deaths or 0.37 per cent mortality.

The Manchester group of gynecologists who perform this operation, including amputation of the cervix during the child-bearing age, allow their patients to go into labor, if pregnancy ensues, and deliver themselves through the birth canal. They show a recurrence ranging from 18.5 to 25 per cent in this group of cases. I personally believe that if a patient has had an amputation of the cervix to an extensive degree, she should not be permitted to deliver herself through the pelvis because of the ever present danger of rupture of the uterus. For this reason I reserve the Manchester operation largely for patients who have reached or passed the menopause. The ages of the patients reported by Shaw in his paper ranged from sixteen to seventy-five years. The oldest patient upon whom I did this operation was eighty years.

In the preparation of the patient for a vaginal operation for prolapse it is essential that two preoperative complications be overcome. All patients should have cystoscopy performed and pyelograms, direct or indirect, should be obtained to determine the course and the condition of the ureters. If upper urinary tract pathologic disorder is observed, it should receive appropriate treatment. In the presence of cystitis it is imperative that it be healed before the operation is performed to prevent ascending infection into the urinary tract and to eliminate one source of postoperative sepsis. At the present time it is not too difficult to heal a cystitis preoperatively because of the availability of the antibiotics and the sulfa group of drugs; attention to this will save a number of hospital days postoperatively. Secondly, the presence of decubitus ulcers on the cervix or on the vaginal walls may mitigate against the healing of the incisions and result in an operative failure. These ulcers may be readily healed by keeping the patient in bed to allow the prolapsed mass to remain within the vagina. This, together with a mild antiseptic and astringent douche daily, will lead to rapid healing.

TECHNIC OF OPERATION

The cervix is dilated and the uterine cavity is curetted. A transverse incision is made in the anterior vaginal wall where it joins the cervix. The superior edge of the incision is made taut with Allis forceps. The anterior vaginal wall is separated from the bladder with curved, sharply pointed scissors, the points of the scissors being directed against the anterior vaginal wall. (Fig. 1A.) The anterior vaginal wall is incised in the median line to a point 1½ cm. below the urinary meatus. (Fig. 1B.) The bladder is separated from the vagina on each side, it is then raised by an Allis forceps and the uterovesical ligament is cut with scissors. Thus the bladder is freed from all of its attachments. (Fig. 1C.) By separating the bladder from the vagina and the cervix the bases of the broad ligaments (parametria) are exposed. Three sutures of No. 1 chromic catgut are introduced in the bases of the broad ligaments and left untied. (Fig. 2A.) The posterior vaginal wall is dissected from the cervix and the cervix is amputated below the lower suture in the broad ligaments. (Fig. 2B.) The posterior vaginal wall is attached to the cervical canal by three or four sutures of No. 1 chromic catgut. (Fig. 2C.) The sutures attaching the posterior vaginal wall to the cervical canal are tied and cut. Three sutures of No. 1 chromic catgut attach the lateral vaginal walls to the anterior lip of the cervix and these sutures are left untied. (Fig. 3A.) The three sutures in the broad ligaments are tied and cut. Interrupted sutures of No. 0 chromic catgut are placed in the musculofascial tissues on the sides of the bladder. (Fig. 3B.) The sutures in the musculo-

fascial tissues on the sides of the bladder are tied and cut. (Fig. 3C.) The cystocele has been corrected. The excess of the vaginal wall on each side is resected, care being taken not to remove too much, so that the edges of the vaginal wall will not be brought together under tension. (Fig. 4A.) The sutures approximating the vaginal wall to the anterior lip of the cervix are tied and cut. The anterior vaginal wall is closed by means of interrupted sutures of No. 0 chromic catgut, starting at the cervix and ending at the upper angle of the vaginal incision below the urinary meatus. (Fig. 4B.) The pelvic floor is repaired. Figure 4C shows the finished operation. Some of the sutures in the anterior vaginal wall show above the repaired perineum.

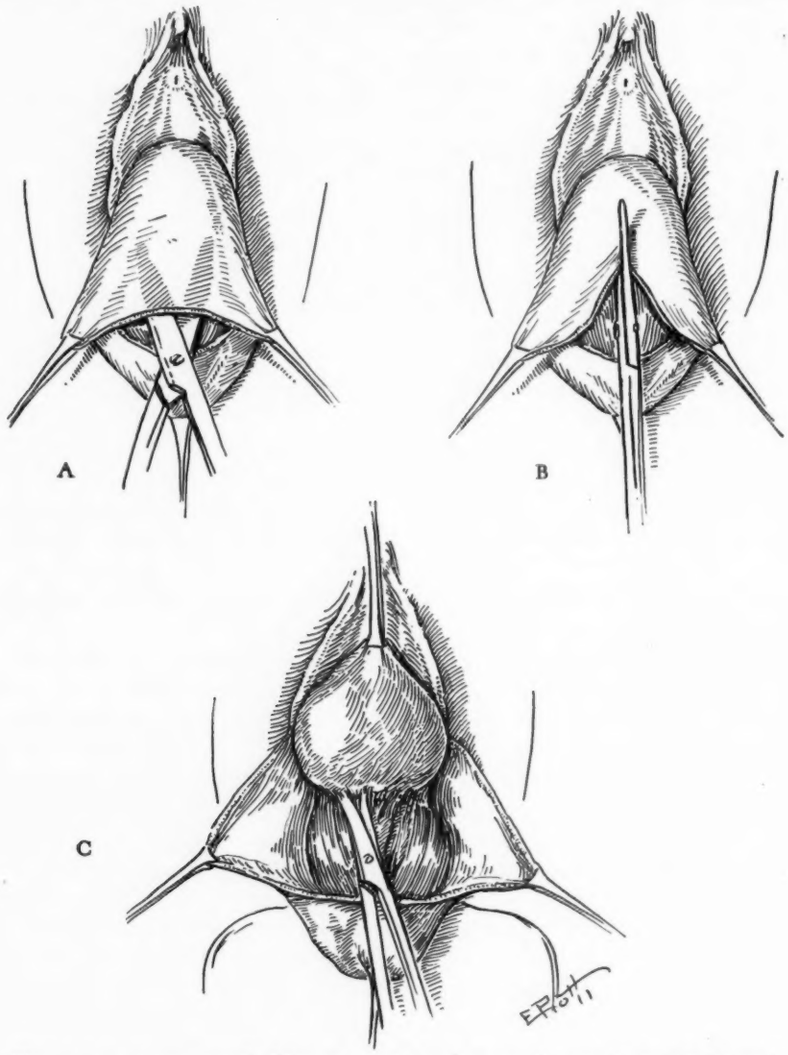

FIG. 1. A, a transverse incision is made in the anterior vaginal wall where it joins the cervix; the superior edge of the incision is made taut with Allis forceps; the anterior vaginal wall is separated from the bladder with curved sharply pointed uterine scissors; the points of the scissors are directed against the anterior vaginal wall. B, the anterior vaginal wall is incised in the median line to a point 1½ cm. below the urinary meatus; C, the bladder has been separated from the vagina on each side; the bladder has been raised by an Allis forceps; the uterovesical ligament is being cut.

STATISTICS

A study of my personal records shows that from January 1, 1933, to January 9, 1951, a period of approximately eighteen years, I have performed the Manchester operation on 126

women. As previously stated, the oldest woman in this group was eighty years of age. There was no mortality in the series. The results were very satisfactory. The first operation performed was a failure. The technic described by W. E. Fothergill in Eden and Lockyer,[2] New System of Gynecology, was followed. The operation consisted of an anterior and a posterior colporrhaphy and amputation of the cervix, the deep structures were not approximated and the incisions were closed in a single layer with interrupted catgut sutures. The recurrence which occurred shortly afterwards was in the form of a medium-sized cystocele. This taught me the lesson that the deep tissues should be approximated independently of the vaginal walls. In a few of the earlier cases there was a lax posterior fornix postoperatively but the results were considered to be satisfactory because there was no protrusion outside of the vulva and the patient had no symptoms. It was discovered that by going higher on the posterior vaginal wall close to the cervix this lax condition of the posterior fornix could be avoided in practically all instances.

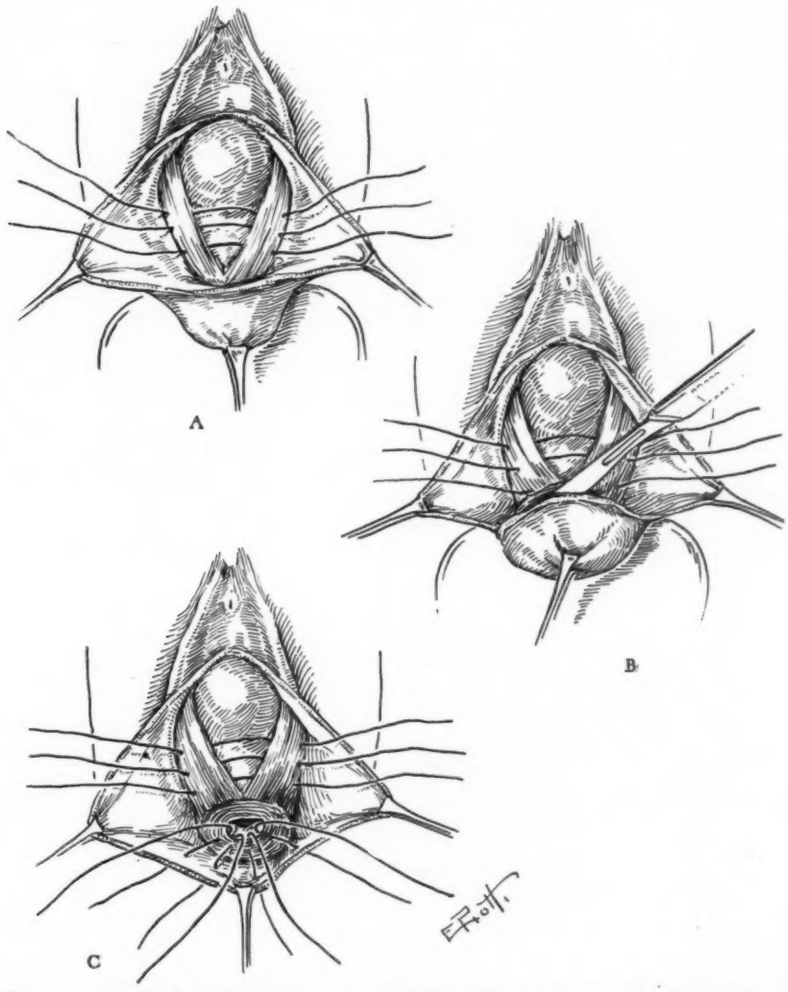

FIG. 2. A, the bladder has been separated from the vagina and cervix; the bases of the broad ligaments (parametria) have been exposed; three sutures of No. 1 chromic catgut have been introduced in the broad ligaments and left untied. B, the posterior vaginal wall has been dissected from the cervix; the cervix is amputated below the lower suture in the broad ligaments. C, the posterior vaginal wall is attached to the cervical canal by three or four sutures of No. 1 chromic catgut.

POSTOPERATIVE COMPLICATIONS

The postoperative complications which may occur consequent to the performance of the

Manchester operation are those which may be found after any extensive vaginal operation for uterine prolapse, namely, retention of urine, secondary hemorrhage from the cervix, occlusion of the cervix, vaginal adhesions and excessive narrowing of the vagina.

bladder drainage gantrisin is prescribed as a urinary antiseptic. After seven days when the catheter is removed, the patient usually voids normally; a few may have to be catheterized for a day or two. This method of constant bladder drainage seems to be better tolerated

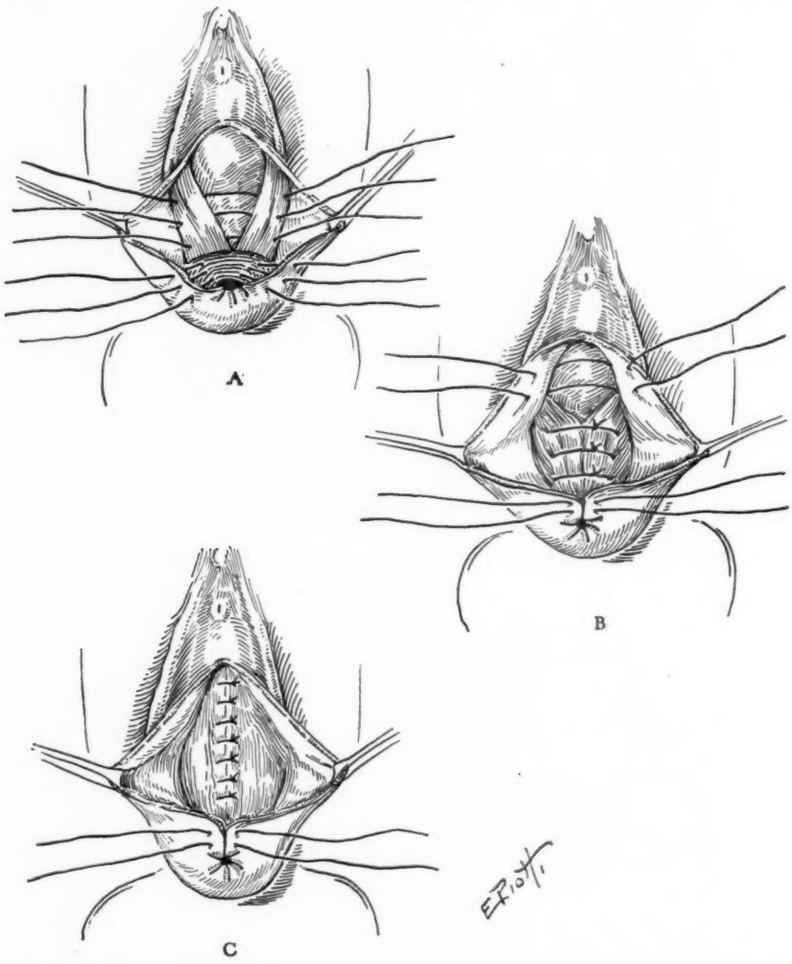

FIG. 3. A, the sutures attaching the posterior vaginal wall to the cervical canal have been tied and cut; three sutures of No. 1 chromic catgut attach the lateral vaginal walls to the anterior lip of the cervix, B, the three sutures in the broad ligaments have been tied and cut; interrupted sutures of No. 0 chromic catgut are being placed in the musculofascial tissues on the sides of the bladder; the lowest suture on the anterior lip of the cervix has been tied and cut, the two remaining sutures are held untied. C, the sutures in the musculofascial tissues on the sides of the bladder have been tied and cut, the cystocele has been corrected.

Retention of Urine. This can be avoided in practically all cases by following a routine procedure established on my service many years ago. At the end of the operation constant bladder drainage is established by a Malecot self-retaining catheter and this is maintained for seven days. During the period of constant

by the patient than does catheterization at frequent intervals.

Secondary Hemorrhage from the Cervix. In my experience this has occurred but rarely. It is usually due to the premature absorption of the catgut sutures which attach the vaginal mucosa to the cervical canal in reconstructing.

the cervix. The use of No. 1 forty-day chromic catgut for these sutures has almost entirely eliminated these secondary hemorrhages which usually occur around the tenth postoperative day.

Vaginal Adhesions. In my experience this has been a rare complication. It occurs when the vaginal flaps have been too widely resected, thus bringing the edges together under tension, causing sloughing of the edges which leads to

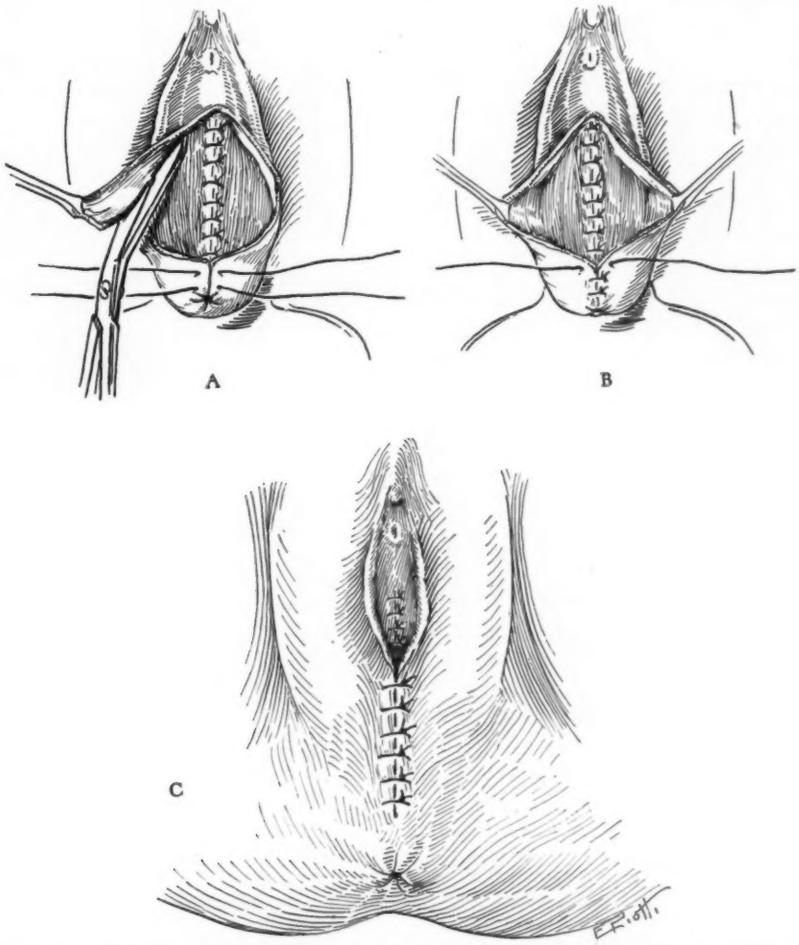

FIG. 4. A, the excess of the anterior vaginal wall on each side is resected. B, the two remaining sutures approximating the vaginal wall to the cervix are being tied and cut; the anterior vaginal wall is closed by interrupted sutures of No. 0 chromic catgut, starting at the cervix and ending at the upper angle of the vaginal incision below the urinary meatus. C, the pelvic floor has been repaired; some of the sutures in the anterior vaginal wall show above the repaired perineum.

Occlusion of the Cervix. This troublesome complication may be prevented by a thorough dilatation of the cervix by means of graduated dilators before reconstructing this organ. If at the end of the operation on the cervix there is any doubt about its patency or about a potential occlusion later, the introduction of a glass or hard rubber stem pessary, to be worn for ten or twelve days during the convalescence, will act as a prophylactic measure against this condition.

adhesions. This complication may be avoided by resecting the vaginal flaps so that they will come together without tension or strangulation. It is for this reason that I prefer to resect the flaps after approximation of the deep tissues when I perform colporrhaphy, anterior or posterior, because by so doing I get a better idea of how much should be removed. Following vaginal plastic operations all patients are examined on the twelfth postoperative day; the examining finger is well lubricated with Irish

moss jelly; if adhesions are found at that time, they are thin and superficial and may be broken up easily. Packing the vagina lightly with vaseline gauze for forty-eight hours usually prevents their recurrence. If this condition occurs, the patient should be examined weekly during the first four to six weeks postoperatively.

Excessive Narrowing of the Vagina. The success of vaginal plastic operations depends upon the knowledge, acquired only by experience, of how much of the flaps should be resected. If the resection is too extensive, it will result in the narrowing of the vagina. As a general principle it is always better to leave the vaginal walls slightly lax and not too tight. It is the deep structures by their approximation that furnish the support; the resected vaginal walls merely act as a covering for these structures. A properly resected vaginal wall will leave a smooth elastic vagina; a vaginal wall that has been resected too extensively will leave a tense, scarred and painful surface.

ANESTHESIA

All forms of anesthesia from general to local infiltration have been used in this group of patients. My preference, however, is spinal anesthesia supplemented with intravenous sodium pentothal® anesthesia (1 gm. of sodium pentothal® in 500 cc. of normal saline solution) given slowly by the drop method. By this practice the relaxation of the spinal anesthesia is obtained, together with the benefit of a light slumber, an ideal combination in the nervous patient.

CONCLUSIONS

1. The Manchester (Donald-Fothergill-Shaw) operation is an excellent procedure in the treatment of uterine prolapse.

2. The operation, while performed on all patients irrespective of age, parity and social standing by the Manchester group of gynecologists, finds its greatest field of usefulness in the management of prolapse in those who have passed the menopause.

3. The cervix, whenever elongated, lacerated or irritated, is amputated in connection with this operation.

4. A high posterior colporrhaphy and perineorrhaphy are complements to this method.

5. The technic of this operation as I perform it is illustrated by means of artist's drawings.

6. A personal series of 126 women operated upon by this procedure without mortality is reported.

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DUODENOSTOMY

TECHNIC FOR MANAGEMENT OF DUODENAL STUMP IN CERTAIN CASES OF PARTIAL GASTRECTOMY FOR DUODENAL ULCER

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IN past years leakage from the duodenal stump has been a prominent source of serious complication after partial gastrectomy of the Billroth II type. At the present time successful closure of the duodenum still constitutes an important factor in maintaining the current low mortality rate after partial resection of the stomach. Dehiscence of the suture line in the duodenum may lead to generalized peritonitis with subsequent fatality, localized peritonitis and subhepatic abscess, or duodenal fistula with resultant loss of fluid and electrolytes and consequent debilitation of the patient.

CLOSURE OF THE DUODENAL STUMP IN ORDINARY CASES

In performing partial gastrectomy of the Billroth II type the lower level of resection may be in one of four general locations in reference to the duodenal ulcer and the pylorus. (Fig. 1.) Ideally, if circumstances permit, the surgeon prefers to sever the duodenum distal to the ulcer and close the duodenal stump in a suitable manner of his preference. (Fig. 1.) This may be accomplished in most cases if the ulcer is not of excessive size, if the duodenum is relatively accessible, if the ulcer is not located at an appreciable distance from the pylorus and if the distance between the pylorus and ampulla of Vater has not been significantly shortened by recurring ulceration and healing. Under these circumstances the duodenal tissues at the site of closure are relatively normal and mobile, and satisfactory suture of the duodenum can be accomplished without too much difficulty.

In other cases in which there is an active, perforating ulcer on the posterior wall of the duodenum and a relatively short distance between the ulcer and the ampulla of Vater one may sever the duodenum at the level of the ulcer, leaving the crater of the lesion on the pancreas. (Fig. 1.) In this instance the posterior wall of the duodenum is carefully mobilized for a short distance beyond the crater of the ulcer. Ordinarily the anterior wall of the duodenum is severed at a level somewhat closer to the pylorus than the posterior wall in order to preserve an adequate amount of freely movable anterior wall to roll over to the posterior wall to permit satisfactory closure without tension. In some cases as the posterior duodenal wall is mobilized it forms a V-shaped edge, with the deep converging limbs of the V directed downward in the mid-portion of the posterior wall. This is especially true if the crater of the ulcer has been situated in the mid-part of the posterior duodenal wall. Under these circumstances the line of closure of the duodenal stump may advantageously be directed from the most dependent level posteriorly to the anterior wall. This is in contrast with the usual direction of the suture line from the inferior to the superior border of the duodenum. Closure of the "open duodenal stump" rather than closure with the aid of a clamp of some type placed across the duodenum is helpful in avoiding excessive mobilization of the duodenum.

Under other circumstances a duodenal ulcer may be situated at a considerable distance from the pylorus (4 cm. or more). In this type of case if there is no bleeding and acute perforation of the ulcer does not appear imminent, the surgeon may elect to sever the duodenum immediately distal to the pylorus and close the duodenal stump proximal to the ulcer. (Fig. 1.) Several words of caution might be offered regarding the use of this procedure. In the first place a greater length of duodenum proximal to the ulcer is necessary for satisfactory closure of the stump than might appear if a suture line without tension is to be obtained. As the region of the ulcer is approached, the duodenal wall becomes fixed, perhaps edematous, and does not lend itself to completely satisfactory mobilization as the sutures are inserted.

Secondly, if the ulcer is to be left in place, one should refrain from freeing the tissues around it or applying much traction on the involved duodenum in order to decrease the chance of leakage from the region of the ulcer during the early postoperative period.

suture line. Third, adequate blood supply of the duodenal wall must be maintained. Fourth, and we believe this point has been inadequately stressed, attention must be directed toward prevention of any increase in the normal intraluminal pressure of the duodenum during

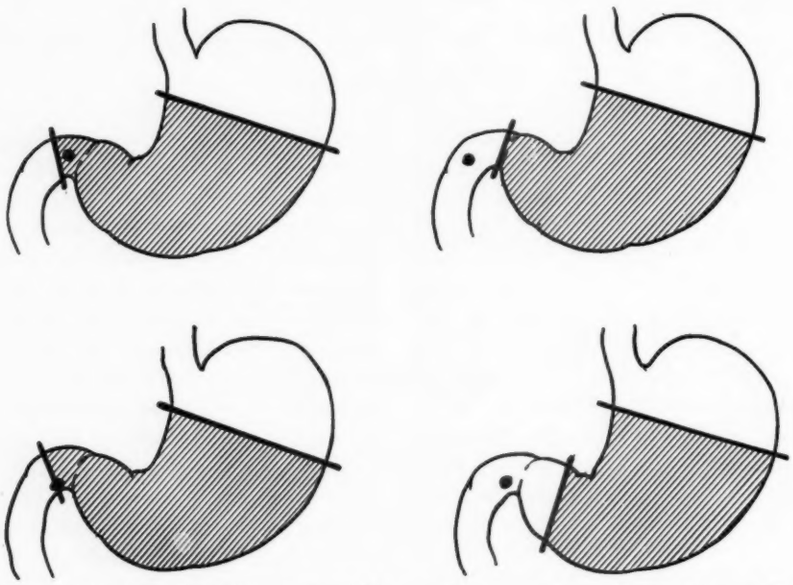

FIG. 1. Various distal levels at which resection may be performed in partial gastrectomy for duodenal ulcer.

In certain selected cases (few in our practice) one may elect to sever the stomach a few centimeters proximal to the pylorus, excise the remaining prepyloric gastric mucosa and close the stump after the method described by Bancroft. (Fig. 1.) This procedure may be employed in the presence of an active duodenal ulcer of such magnitude and position that no type of resection through the duodenum appears to be safe or wise. In our opinion it should not be performed if the ulcer is bleeding or causing an advanced degree of obstruction.

Certain technical points are of course important in obtaining satisfactory closure of the duodenal stump. A number of methods and procedures have been suggested and employed in closure of the duodenum. Without discussing technical details certain general principles might be mentioned. First, it probably goes without saying that satisfactory inversion of the cut end of the duodenum is essential. It is our practice to use at least three rows of sutures, all but the first being of silk. The suture line is then "rolled" into the adjacent pancreas. Second, there must be no tension on the

the postoperative period. This, of course, means that there must be no degree of obstruction in the proximal loop of the jejunum. We are inclined to believe that increased pressure within the duodenum has been responsible for leakage from more than one duodenal stump. It is our belief that use of a truly short proximal loop of jejunum in establishing the anastomosis is helpful in this regard when a posterior type of gastrojejunal anastomosis is made.

DUODENOSTOMY

In certain unusual cases the surgeon may experience difficulty in closing the duodenal stump by any of the conventional methods. Such a situation may arise if for any reason the duodenum has been severed so far distally that its satisfactory closure in an ordinary manner might encroach on the common bile duct. In our opinion partial gastrectomy for duodenal ulcer should never be planned in such a manner that reimplantation of the common bile duct into the duodenum is required. Occasionally, however, because of unexpected findings as the operation progresses or for other reasons one

may find that closure of the duodenal stump in a usual manner might result in undesirable encroachment on certain important adjacent structures. Under these circumstances management of the duodenal stump by performance of duodenostomy may prove to be quite helpful. (Fig. 2.) This procedure consists simply of closing the open end of the duodenum around an appropriate catheter, perhaps a size 20 F straight latex type. That portion of the duodenum which can be sutured satisfactorily is closed and the catheter is permitted to remain where satisfactory closure is difficult or impossible without endangering adjacent structures or the wall of the duodenum by further mobilization. Purse-string sutures placed around the catheter may be helpful. Nearby fatty tissue may be sutured around the catheter if further protection of the closure appears advisable. The catheter is brought out of the abdominal wall through a stab wound. The cathether is anchored securely to the skin by a sturdy nonabsorbable suture. A Penrose-type drain may be left near the end of the duodenum if one wishes and brought out a different tract through the abdominal wall.

The catheter is connected with a bottle at the conclusion of the operation so that fluid which drains from the duodenum may be collected and measured. This, of course, is helpful in judging the need for replacement of fluid and electrolytes. There may be relatively little drainage from the duodenum. Ten or twelve days after operation the catheter may be clamped to observe any untoward effects that might result. In our limited experience with this procedure no such results have been observed. The catheter may be withdrawn twelve to fourteen days after operation. The sinus tract may be expected to heal quite promptly.

COMMENT

Duodenostomy is not a new procedure. Billroth (as quoted by Wölfler in 1881) considered the advisability of leaving a duodenal fistula in his descriptions of the first successful gastric resections. Neumann in 1909 used a rubber catheter or drain in two cases of perforated gastric ulcer in which the opening could not be closed by suture. Keynes in 1934 reintroduced Neumann's method in England for the management of both perforated gastric and duodenal ulcers. He inserted a mushroom type of catheter into the opening and closed the tissues around it with purse-string sutures. Other surgeons[3,4] have utilized this technic in certain cases of perforated ulcer in which they were also unable to obtain a satisfactory closure with sutures alone. Welch described the use of

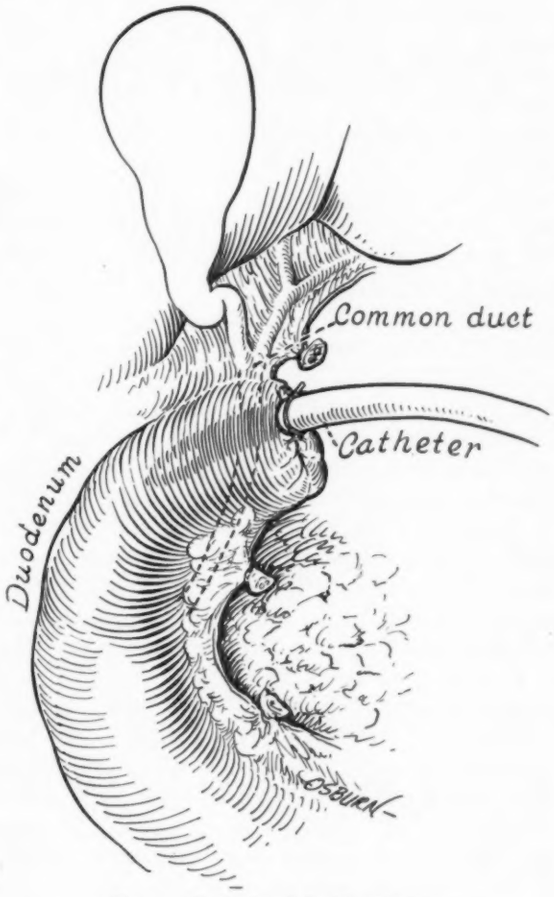

FIG. 2. Technic of duodenostomy.

a catheter in the duodenal stump after gastric resection in several cases of bleeding duodenal ulcer. The technic described by us is in all essentials identical with the method that Welch used.

It is not suggested that duodenostomy should ever be selected as the method of choice in managing the duodenal stump but rather that it should be used as a method of election when other methods cannot be used with safety. The underlying surgical principle is similar to the use of a T tube in drainage of the common bile duct after choledochostomy. The method may be of some value in the occasional case in which the surgeon believes that duo-

denal leakage is probable or inevitable if a more usual form of closure is used.

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THE TRAGIC EFFECTS OF DELAY ON THE RESECTABILITY AND SURVIVAL RATE OF CARCINOMA OF THE COLON

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ACCORDING to Duke's classification, carcinomas of the colon are of three types depending upon the extent of their penetration. Type A consists of those limited to the bowel wall, type B those which have penetrated into the pericolic tissues, and type C those extending into the lymph nodes or beyond. In considering the lesions from this viewpoint one is impressed with the significance of the time element in the prognosis. The tragic fact is, however, that an average of nine to twelve months elapses between the appearance of symptoms and the time the patients come to surgery. During this period the vast majority of growths will have spread beyond the colon walls and into the glands.

Obviously this problem of delayed diagnosis and treatment of malignancies is a matter for the most serious consideration. Primarily, of course, the fault lies with the patients. Many individuals postpone going to a doctor so long as they are not particularly incapacitated. The symptoms often begin so insidiously and increase so slowly that they cause little concern until a permanent cure is out of the question. Such situations can be prevented only when the public awakens to the fact that any change from the normal state of health, even though slight, may be a signal of a dangerous disorder.

At times the delayed diagnosis and the consequent poor prognosis may be attributed to failure of the physician who first sees the patient to discover or recognize the malignancy. Few physicians will neglect to obtain a blood count of a patient who complains of exhaustion; yet when profound anemia is discovered, they may keep the patient on antianemic therapy indefinitely until his decline becomes so obvious as to demand a proper investigation. Again, physicians occasionally are prone to regard a functional disturbance of the colon merely as a natural accompaniment of advancing age or to ascribe it to some associated disease and to treat the patient medically until pain and passage of blood enter the picture. Not infrequently even a bleeding malignancy of the rectum is mistaken for hemorrhoids, a fissure or some other benign lesion. Reports indicate that from 12 to 25 per cent of rectal malignancies are treated either medically or surgically as hemorrhoids.

Although we may be a long while in changing radically the prognosis of carcinoma of the colon insofar as it depends upon patients seeking regular examination or at least consulting a physician at the earliest sign of trouble, we can by our own alert attitude materially improve the outlook for many of these victims. In the first place we can remember that any unexplained anemia, loss of appetite and dyspepsia may mean a colon malignancy, especially of the right half; also, that an alteration of bowel function, low abdominal pain and the passage of blood suggest an obstructing growth, usually on the left. In the second place we can make a digital examination of the rectum of every patient, regardless of complaint, and a sigmoidoscopic examination of those with symptoms of a colon disorder. That more than 50 per cent of carcinomas of the colon are situated in the rectum and rectosigmoid makes such an examination all the more imperative.

Once the possibility of a malignancy is indicated by the history, the fullest investigation is in order. Halfway measures have no place in the search for any disease and least of all for malignancies. This means roentgen study of the entire colon by the double contrast method; not all carcinomas are demonstrable following a barium enema alone. It also means a biopsy of all lesions demonstrated by digital and sigmoidoscopic examination, as only thus can one avoid mistaking a malignancy in the rectum or rectosigmoid for a benign disease.

Fortunately the prognosis of carcinoma of the colon is more favorable than that of carcinoma in any other part of the body provided it is discovered reasonably early. Lesions on the right are usually of the proliferative type; they

grow into the lumen rather than outward and thus are late in extending to the lymphatics. Carcinomas of the left colon invade and constrict the bowel wall and, once the entire wall is penetrated, tend to early spread. Our best hope in the presence of malignancies on this side lies in the fact that they are usually scirrhous in type and grow slowly. Also, being obstructive they produce symptoms fairly soon. Carcinomas of the rectum and rectosigmoid should offer the brightest prospect of all in that they are subject to direct visualization.

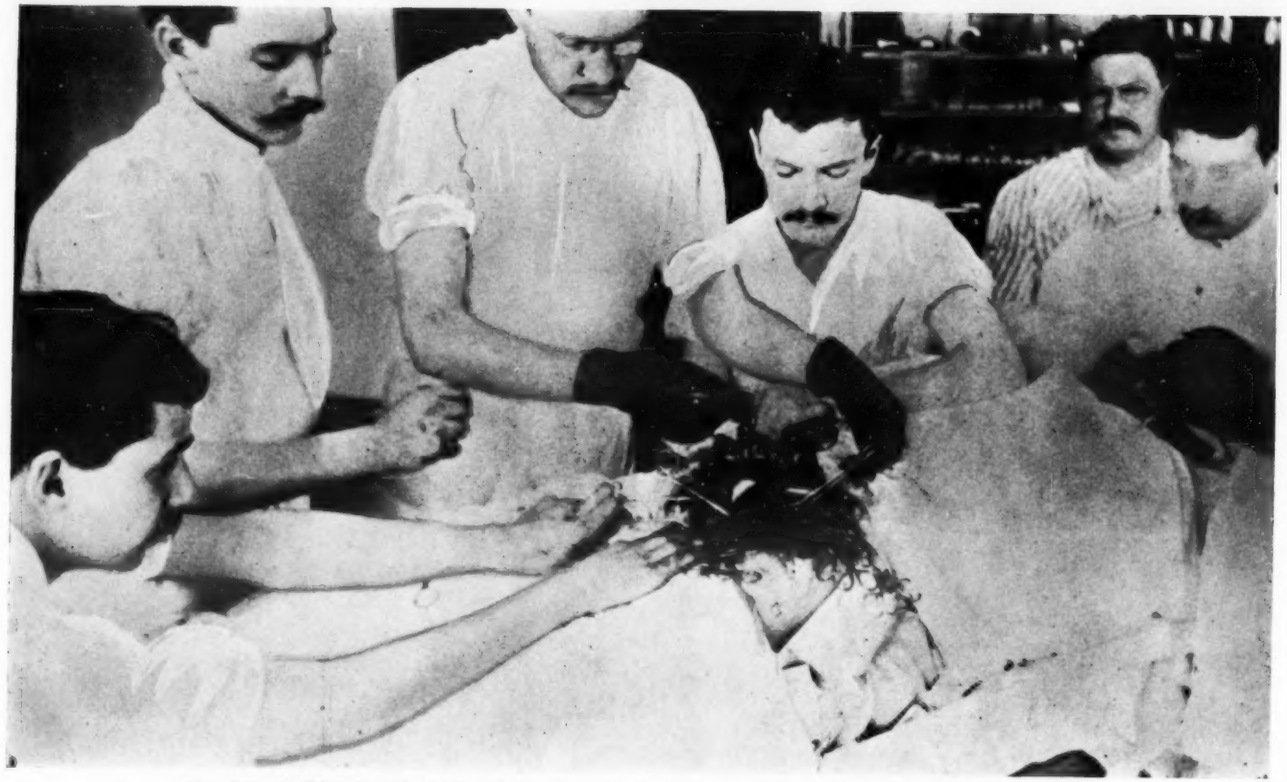
Despite these favorable features cures of carcinoma of the colon must still be measured in terms of a few years. Not only this, but on the whole less than one-half the patients survive even five years. Of those without metastasis the five-year survival rate is between 50 and 60 per cent whereas of those with metastasis it is between 20 and 30 per cent.

A not inconsiderable number of these poor results are traceable fundamentally to a lack of understanding on the part of medical men and surgeons of the origin, development and principles of diagnosis and treatment of surgical lesions of the colon. Indeed, with the possible exception of thyroid diseases lesions of the colon are probably less well understood than any group of ailments to which the human body is heir. Surgeons of many years' experience in treating a large volume of colon diseases are often confronted with evidence of this fact. For example, we continue to observe cancers which originate in ulcerative colitis and polyposis. It has long been known that such lesions have a definite tendency to malignant degeneration, yet apparently the matter is still not generally understood; otherwise most if not all of those who have such a lesion might be saved by preventive surgery.

No doubt, moreover, a wider knowledge of the structure and function of the colon, the distribution of the blood and lymph supply and the different pathologic types of malignancy in the two halves would be reflected in earlier diagnoses, better surgery and more favorable prognoses.

Insofar as the operation itself is concerned, the surgeon is responsible in no small measure for the fate of these patients. The immediate and ultimate result of the surgical procedure depends first upon the thoroughness of the supportive measures both preoperatively and postoperatively, and second upon the extent of the resection. We no longer send the patient to the hospital one day, give him one transfusion and operate the next. Rather, the period of preparation is prolonged sufficiently to permit rehabilitation of the patient that he may be brought safely through the procedure, even though it is of the most radical nature. Indeed, the administration of multiple transfusions and other therapy in ample degree has materially influenced the ultimate as well as the immediate prognosis since it has made possible the removal of growths which formerly would have been regarded as hopeless.

Given a carcinoma that is resectable, its complete extirpation will depend upon the skill and judgment of the surgeon. The truth is, a wide variance exists in the resectability of these growths by experienced surgeons and by those of little experience. Surgery of the colon is an undertaking of major proportions and one which only those who have a full knowledge of surgical principles and technic should attempt. If it is impossible to gain this knowledge first hand under the direct supervision of a surgeon of experience, at least written and spoken articles on the subject are available. Both medical men and surgeons who are well versed in these principles should set themselves the task of instructing all who would engage in such work by bringing the subject to the forefront in the classroom and at medical meetings. The present disparagement between the actual and potential results of treatment constitutes a challenge to all of us to more intensive effort both in bringing these patients to treatment early and in improving the practice of colonic surgery. Only by this means can any real progress be made in altering the present tragic situation with respect to the prognosis of carcinoma of the colon.



Dr. Joseph Bloodgood (with rubber gloves), during operation at Johns Hopkins Hospital.

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RADICAL OPERATION FOR CARCINOMA OF THE EXTERNAL AUDITORY CANAL AND MIDDLE EAR*

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THE results of treatment of primary carcinoma of the external auditory canal and middle ear are very disappointing. The outlook for patients with secondary involvement of the ear from carcinoma in nearby structures is also discouraging and usually considered hopeless. The reasons for this grave outlook are predominately delay in diagnosis, limited therapeutic procedures and difficulty of access to this region for evaluation and treatment.

The diagnosis is often made after the tumor is far advanced. The patient frequently has had prolonged therapy for a supposedly benign lesion. With extensive disease it is difficult to achieve satisfactory results by any approach. All of our five patients had advanced disease and hence the results are far from satisfactory. They demonstrate the need for early diagnosis.

The major symptom of carcinoma in this location is pain, especially significant when the local changes are not striking. Secondary only to pain is bloody otorrhea. Otorrhea may often precede the onset of neoplastic lesions of the middle ear and external auditory canal, but the appearance of blood in this discharge should prompt a thorough investigation and arouse suspicion of the presence of cancer. Hearing loss, vertigo and ipsolateral facial paralysis may also occur.

Long-standing pre-existing inflammation in the mastoid or inflammation secondary to the presence of neoplasm almost always produces radiologic changes in the mastoid. Radiographs of the mastoid, therefore, are usually valueless in determining the presence or absence of extension of the tumor into the mastoid.

When the question of the presence of neoplasm arises, an attempt at direct biopsy should be made. Bloody discharge may be accompanied with a mass or ulcer in the external canal but often has origin behind an almost intact tympanic membrane. In some cases examination of a painful ear reveals a mass behind the tympanic membrane causing it to bulge and not accompanied with drainage. An exploratory operation to visualize the middle ear cavity or mastoid should, therefore, be utilized to establish the diagnosis in suspicious cases. This operation can be either a routine mastoidectomy approach or an exploration of the middle ear by reflection of the tympanic membrane. Aggressiveness in diagnosis, however, depends on a high index of suspicion in the examiner who first sees the patient.

Squamous cell carcinoma is the most common type of malignant tumor occurring in the region of the external auditory canal and surrounding structures although other tumors have been reported with a similar clinical picture. The list of tumors occurring in the middle ear and external auditory canal includes basal cell carcinoma, adenocarcinoma, sarcoma, granular cell myoblastoma and ectopic parotid and glomus jugularis tumors. All our cases were squamous cell carcinoma but one was suggestive of cylindroma. It was in this particular patient that we were never certain of the primary site of growth. In general, the problem in this group is that of squamous cell carcinoma invading bone, adjacent soft tissue and cervical lymph nodes.

At present the unsatisfactory therapeutic results, once the diagnosis has been established, are due to an insufficiently radical surgical approach. Most authors describe an operation with supplementary postoperative irradiation. A routine radical mastoidectomy is the usual surgical procedure and the irradiation is either external or by radium tubes placed in the wound. This type of treatment is unsatisfactory because it does not attack adequately the cervical metastases, the primary site and the local extension into the soft tissues. The extent of these processes is difficult to evaluate pre-

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operatively and surgical procedures used for benign conditions are not radical enough.

The necessity for neck dissection should be emphasized. When the diagnosis is established, the possible presence of regional lymph node metastases in the neck usually is not fully appreciated. It is uniformly stressed in the literature that primary carcinomas of the external canal and middle ear rarely metastasize to the neck. In all of our cases of both primary and secondary carcinoma of the ear involved nodes were present. The nodes were not palpable preoperatively in two of the cases but were found in the operative specimens. We have found secondary spread high in the neck and beneath the mastoid tip which could not conceivably be palpated preoperatively. For these reasons the operative procedure must not only be more radical in the region of the tumor but also must include resection of the cervical lymph nodes whether palpable or not. If neck dissection is to be done, it should be in continuity with the removal of the primary lesion. This concept of resection in continuity was first applied to breast carcinoma by Halsted,[1] and later stressed by Pack et al.[2] in the treatment of malignant melanomas. This approach has been described by Slaughter et al.,[3] Ward and Robben,[4] Sugarbaker and Gilford,[5] and their collaborators. This method of removal of a primary tumor and its lymphatic drainage in one block so far as possible has application to the problem under discussion.

Five patients have been submitted to a radical operative procedure for carcinoma involving the middle ear region. Three had primary carcinoma of the external auditory canal with local extension to the middle ear and adjacent soft tissues and metastases to cervical lymph nodes. One who first appeared with a cervical mass just below the mastoid eminence had a primary lesion of an unknown site. She later developed involvement of the middle ear and consequently her therapy was somewhat different from the others. Another had a primary carcinoma of the pre-auricular skin which we previously treated by excision. The recurrence manifested itself by extension to the middle ear, mastoid and overlying soft tissue.

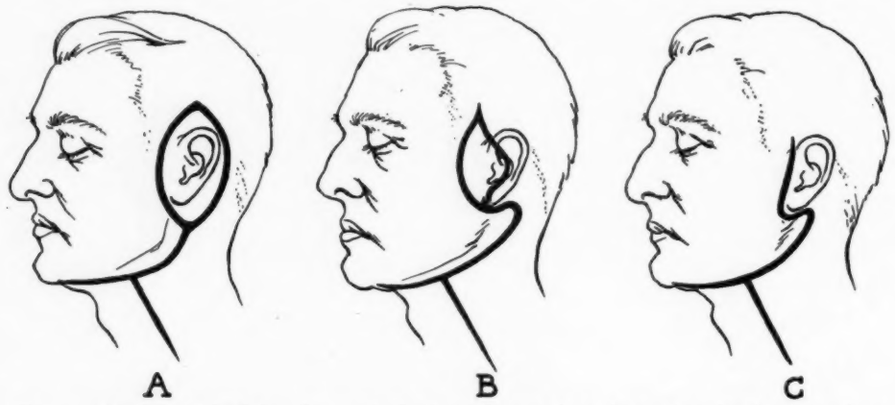


FIG. 1. Kocher Y incision for radical dissection of lymph-bearing fascia of neck. A, posterior end of horizontal limb extended in an elliptical manner to include entire pinna which is removed with the specimen; B, extended ellipse includes tragus and involved preauricular skin, Case IV; C, incision extended in the preauricular region for reflexion of pinna posteriorly to reach external auditory canal. This incision permits pinna to be resutured.

PROCEDURE

No special preoperative preparation is carried out. We explain to our patients the unavoidable postoperative facial palsy. To all, this is a matter of no hesitation in light of their severe pain. Sodium pentothal® is given supplemented by endotracheal oxygen and nitrous oxide. The patients are positioned on the operating table as for a radical neck dissection. The incision used is a Kocher Y, permitting dissection of anterior, posterior and superior skin flaps to expose the field. (Fig. 1.) When possible to save the pinna the posterior limb of the Y is extended upward anteriorly in the pre-auricular region and the pinna reflected back. (Fig. 1C.) At the end of the operation it is resutured in position. An involved pinna or portion of it is removed with the specimen.

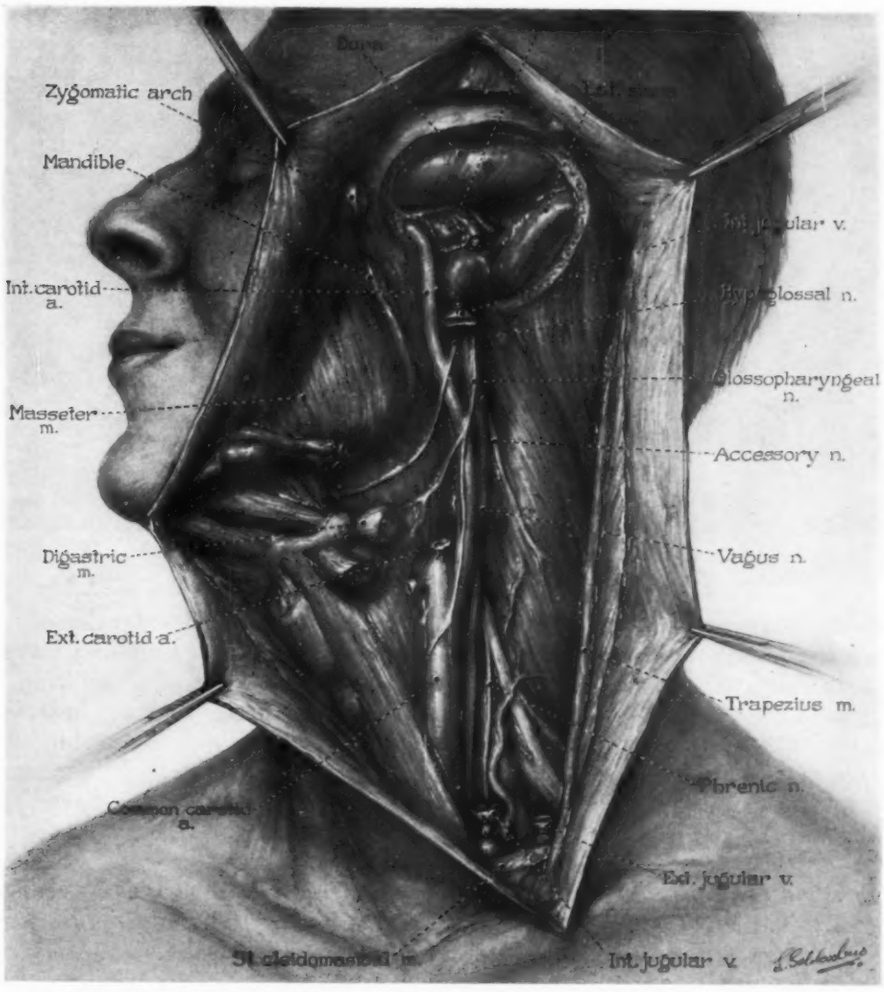
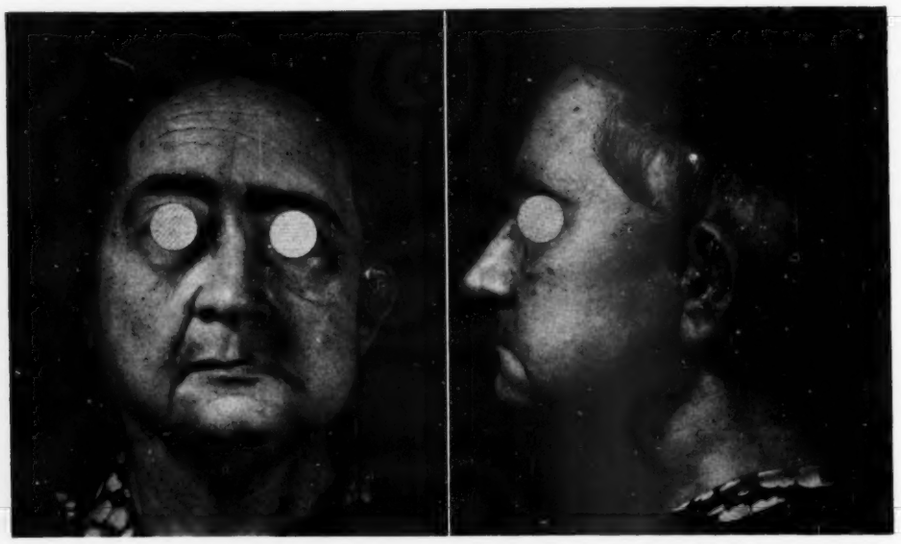


FIG. 2. Deep structures of neck exposed following block resection of lymph-bearing fascia, together with sternomastoid, omohyoid, stylohyoid and posterior belly of digastric muscles and internal jugular vein. The mastoid process and adjacent portion of temporal bone have been ronjeured away showing internal carotid artery and its bony canal, the lateral sinus and dura.

The procedure adhered to in the cervical portion of the operation is the usual classic neck dissection. We begin by transecting the sternocleidomastoid muscle to expose the jugular vein. The vein is ligated just above the clavicle with four silk ligatures and divided between the two middle ligatures. The sternocleidomastoid muscle, together with the jugular vein, carotid sheath and lymph-bearing fascia, is dissected superiorly, care being taken to clean out the posterior triangle of the neck. The posterior limit of the dissection is the edge of the trapezius muscle and in this portion of the dissection the spinal accessory nerve is isolated and preserved when possible. The submental and submaxillary triangles and remainder of the neck fascia is dissected out in the routine manner up to the mandible and as far posteriorly as the angle of the jaw. The posterosuperior limits of the dissection are the most difficult and the dissection here varies somewhat depending on the extent of the tumor.

In three of the patients the parotid gland, facial nerve and varying amounts of preauricular skin were excised *en bloc* with the cervical specimen. In all but Case 1 a portion or all of the pinna was excised with the specimen due to the invasion by or proximity of the tumor. The lymph node metastases in the region of the mastoid eminence made it necessary in several patients to resect, with the specimen, generous portions of the splenius



3A 3B

FIG. 3. Case I, A and B, postoperative photographs.

capitis muscle as involved nodes seemed fixed to its anterior surface near the base of the skull. The jugular vein is ligated and divided as high as possible. (Fig. 2.)

In several patients the dissection near the jugular foramen was tedious as tumor-bearing tissue was in such proximity that a clean dissection was difficult. In fact, a small portion of hidden tumor tissue in one case had to be excised separately after removal of the mastoid tip with rongeurs. The muscle attachments to the mastoid eminence are shaved cleanly from the bone. This, with a generous dissection of the posterior skin flap from the temporal bone and excision of part of the overlying skin and pinna, often leaves a partially denuded temporal bone. The specimen is transected at its remaining attachment in the external auditory canal.

In three of the patients the condyloid process of the mandible was excised with the block. In two cases the zygomatic arch was sectioned anteriorly and removed with the specimen by division at the base of the temporal portion.

When the huge block described is finally removed by division deep in the external auditory canal, the *en bloc* principles are unavoidably discarded because of further extension of the growth into the adjacent bones. The entire region is so exposed that a very radical mastoidectomy can be performed.

The mastoid process is resected extensively always uncovering the lateral sinus, the jugular bulb and the dura mater, and frequently unroofing the carotid artery. This allows careful inspection for possible extension of malignancy. Involved parts of the dura may be resected and replaced with fascia. Extension of the tumor into the pyramid requires resection of the pyramid according to the technic of Lempert[6] or Rasnadier.[7] The bony structure of the external canal is always removed since tumor is often found in adjacent soft tissue. The capsule of the temporomandibular joint is exposed and resected when necessary. When roughening of the labyrinthine bone can be demonstrated, the labyrinth should be removed *in toto*. The facial nerve is frequently imbedded in tumor and must always be sacrificed. In some instances it is divided earlier during total excision of the parotid gland.

From the nature of the piecemeal excision of tumor from the bone, it is evident that carcinoma cells may remain in the walls of the saucerized cavity in the bone. This was especially true in the two cases in which carcinoma extended as far as the dura. It was, therefore, imperative to follow the operation in all cases with irradiation therapy. In all but one patient the portion of the wound overlying the region of excavation of bone was packed open. The neck wound was closed. In most cases primary closure of the wound would have been impossible due to excision of portions of the pinna and adjacent skin that seemed fixed to carcinoma. From three to seven days after operation x-ray therapy into the open wound was begun. Five to six thousand r without filtration was given in a relatively short period of time

(six to ten days) and the wound immediately closed. It is at times necessary to remove necrotic bone after radiation. In one case a secondary closure was possible. In three patients a split thickness graft was used to cover the bone defect before the full impact of reaction from the irradiation was attained. (Fig. 4.) The grafts were quite thin and the takes were satisfactory. In one case a large defect was covered satisfactorily by rotation of a skin flap from the scalp with immediate application of a split thickness graft to the donor site of the scalp. (Fig. 6B.)

CASE REPORTS

CASE 1. This patient, a white female seventy-two years old, had chronic eczema of her external auditory canal for fifteen years. A small, tender mass appeared in her parotid region and then subsided. A small ulcer appeared in her external auditory canal several months later. This was biopsied (October, 1948) and the microscopic sections showed squamous cell carcinoma.

Examination on October 11, 1948, revealed a firm, fixed, tender swelling in the preauricular region measuring 4 cm. in diameter. The external auditory canal was filled with exudate. The tympanic membrane was thickened but intact. There were no palpable lymph nodes in the neck. Roentgenograms of the mastoid region showed no erosion of the auditory canal and no abnormalities.

X-ray therapy was begun in preparation for surgery but the patient did not tolerate it well. One month later she developed a facial palsy, her hearing decreased markedly, and she began to have severe pain in her ear.

Skull x-rays showed increased rarefaction of the squamous portion of the left temporal bone just behind the left meningeal artery. The petrous ridge and mastoid showed no definite involvement.

The operation was performed on December 15, 1948, as described. In this patient it was not necessary to resect overlying skin or pinna. The parotid gland, condyloid process of the mandible and the temporomandibular joint were removed with the specimen. The mastoid and middle ear were found filled with tumor. The dura mater was exposed over an area 3 by 4 sq. cm. during the excavation of diseased bone. Pathologic sections showed squamous cell carcinoma. There were cervical metastases.

FIG. 4. Case II, postoperative photograph.

Postoperative course was as follows: The wound healed satisfactorily and the pain was much relieved. (Figs. 3A and B.) Irradiation of the area described in which dura was exposed was begun six days after operation. She received 2,450 r, measured in air, through a 10 by 10 cm. field in a two-week period. Six months after operation a recurrent nodule developed, 2 by 4 cm., low in the neck. At that time the mastoid cavity was clean and there was no evidence of local recurrence. Nine 3 mc. radon seeds were implanted in the nodule giving a dose of 3,600 mc. hours. The nodule shrunk in size. The patient died five months later after a two-day illness. She had no further evidence of recurrence in the neck or ear region. No autopsy was done.

CASE II. In the patient, a white female aged seventy, a small lesion developed at the orifice of the external auditory canal which later became ulcerated. A biopsy was done two and a half years previous to her initial visit and she was given a course of x-ray at another clinic.

The last radiation was given six months prior to our initial examination. In the last three months she developed a slowly progressive facial paralysis on the right. She continued to have pain and a bloody discharge from the right external auditory canal.

Examination showed a well preserved lady of seventy years who had a right facial palsy. The right ear was curled somewhat and partially destroyed in the concha, exposing a portion of

5A 5B

FIG. 5. Case IV, A and B, preoperative photographs.

cartilage. There was a skin defect at the site of the external auditory canal and the anterior, superior and posterior portions of the external auditory canal were destroyed. The mastoid had a large cavity within it, approximately 2½ cm. in diameter, with dirty granulation tissue and exposed bone. The dura was exposed over the tegmen antri. The capsule of the temporomandibular joint was visible in the cavity. The destruction extended into the root of the zygomatic process. Hearing was absent on this side. Beneath the ear there was slight thickening over the insertion of the sternocleidomastoid muscle. There were no enlarged lymph nodes palpable. Radiologic examination of the skull showed the cavity described with a surrounding zone of dense sclerosis.

The operation herein described was performed on June 15, 1949, and in this patient the pinna with an area of surrounding skin was excised with the specimen. The extension of the tumor into surrounding tissues also required resection of the parotid gland, zygomatic arch and temporomandibular joint. A large area of dura mater was exposed during the bone excavation, a portion of which seemed superficially involved with cancer. The neck wound was closed but a large skin defect in the temporal region remained. Pathologic sections showed extensive squamous cell carcinoma with cervical metastases.

Five days after operation x-ray therapy was started over the 6 by 6 cm. defect left in the temporal region at operation. The area received 2,000 r at 120 kv. on each of three successive days, a total of 6,000 r (unfiltered). Five days later a dermatome graft was placed over the defect. There was a 60 per cent take and the previously exposed dura was entirely covered. The only portion of the graft lost was that overlying bone. (Fig. 4.)

The patient was discharged and the wound became almost completely epithelized. She remained free of symptoms and free of carcinoma for seventeen months. She then died following a severe fall at the age of seventy-two.

CASE III. The patient, a white female aged fifty-two, complained of pain in the right neck and dysphagia of three months' duration. A swelling in the right neck had been present for one month.

Examination revealed this was an emaciated woman who was groaning with severe pain. She had a stony hard, fixed, tender mass, 3 by 5 cm., which extended forward and inferiorly from the mastoid eminence. Ear, nose and throat examination was normal. Chest and sinus x-rays and gastrointestinal x-ray series were also normal. Radiographs of the mastoids showed both to be sclerotic. Biopsy of the cervical mass showed squamous cell carcinoma with an appearance suggesting cylindroma. It

6A 6B

FIG. 6. Case IV, A and B, postoperative photographs

was not possible to determine the primary site of this growth.

Radon seeds (ten 3 mc. seeds) were implanted at operation on November 8, 1948, at which time the mass was found to be definitely separate from the esophagus. Following this both pain and the mass subsided. On January 4, 1949, (two months later) a radical neck dissection was performed with excision of the tumor mass and ligation of the common carotid artery. Improvement followed but two months later on routine examination an ulcer was found in the floor of the external auditory canal. Biopsy showed squamous cell carcinoma and she received x-ray therapy to the neck and ear region (total 2,500 r). Two months later she was given radium (300 mg. hours) in her external auditory canal. Following this there was no activity of the lesion in the auditory canal and no evidence of recurrence in the neck. Over the next few months she had an increase in pain and again developed dysphagia by September, 1949. Radiographs showed the previous sclerotic changes in the mastoid plus enlargement of the external auditory canal and distortion of the right petrous pyramid. Eleven months after initial treatment operation was again performed.

At operation, October 6, 1949, an incision was made behind the pinna and around to the angle of the mandible allowing clear exposure of the mastoid, auditory canal and upper neck. A very radical mastoidectomy was performed exposing the internal carotid artery in its canal. Overlying soft tissues were resected as well as the soft tissues inferior to this, separating the field of operation from the superior border of the previous neck dissection. The wound was packed open to facilitate postoperative irradiation. Microscopically this was an undifferentiated squamous cell carcinoma.

Her pain subsided markedly in the early postoperative period. Four days after operation unfiltered x-ray was applied to the open wound. She received 1,000 r at 140 kv. on six successive days, giving a total dose of 6,000 r to the area of saucerized bone. The wound was closed. There was delayed healing of the skin due to tension and the irradiation therapy. She continued to have some pain but not of the severity experienced prior to operation. She died two months after operation. No autopsy was performed but it was presumed she had recurrent cancer.

CASE IV. Five months before being seen in our tumor clinic this patient, a white male aged forty-nine, noted a small papular lesion in the left pre-auricular region. He was treated by a dermatologist by means of electrodessication. The lesion did not heal completely and a recurrence developed in the margin of the scar.

Examination revealed there was a 2 by 4 cm. scar in the pre-auricular region with a small, firm, papillary area at its margin.

The course was as follows: The area of residual disease and surrounding scar was excised April 27, 1949. A full thickness graft was applied to the surface defect. Pathologic sec-

7A 7B

FIG. 7 Case V, A and B, postoperative photographs.

tions demonstrated recurrent tumor but there were no malignant cells in the margin of the resected specimen. The patient did well for five months and then developed inflammation under one portion of the graft and a pustule in the external auditory canal. This was drained and he was given a course of penicillin. Subsequently x-ray examination revealed osteolytic changes in the temporal bone, zygomatic arch and condyloid process of the mandible. Six months after the excision the pre-auricular area was drained and biopsies were taken. Much exudate was obtained but pathologic sections showed squamous cell carcinoma. The patient was then given 5,300 r at 250 kv. to a 10 by 10 cm. field over a six-week period. (Filter 2 mm. Al, 1 mm. Cu.) At this time some hearing loss and marked otorrhea had developed.

Preoperative examination revealed there was a fullness in the left zygomatic region and a small draining sinus in the pre-auricular region. The external auditory canal was filled with exudate. Hearing was diminished. He had some trismus, but intraoral examination was normal. An early facial weakness could be detected and the cervical lymph nodes were not palpable. (Fig. 5A and B.)

The operation was performed on February 14, 1950. The adherence of malignancy to overlying skin required resection of the pinna and a generous portion of pre-auricular skin with the specimen. Resection of the ascending ramus of the mandible, zygomatic arch, parotid gland, temporomandibular joint and adjacent soft tissues was necessary due to the marked invasive quality of this recurrent tumor. During the mastoid resection an area of dura 4 by 4 cm. was exposed. The skin incisions were closed leaving a large defect in the temporal region. Pathologic sections revealed squamous cell carcinoma in the mastoid, middle ear, adjoining structures and cervical lymph nodes.

The postoperative course was as follows: The patient's pain was completely relieved by the procedure. Six days after operation irradiation of the open wound was begun. He received 6,000 r (unfiltered) at 400 and 250 kv. in a ten-day period. Six days after completion of this therapy a plastic closure was performed by means of a scalp skin flap. The defect in the scalp was covered with a split thickness graft. (Fig. 6A and B.) Five months after operation he was explored by the neurosurgeons because of glossopharyngeal pain. No recurrence was found and nerve section was performed. He did well until seven months after operation when a small abscess appeared in the upper neck. Biopsy of this area showed recurrent carcinoma. He was given 2,800 r (unfiltered) at 250 kv. in a period of one week to a 6 cm. area on the neck. He died nine months after operation with probable intracranial extension of malignant disease.

CASE V. This patient, a colored female aged forty-one, had onset of pruritis in her external auditory canal eighteen months prior to her initial visit. Six months before she began to have a blood-tinged discharge. Her local phy-

sician found a 5 mm. ulcer in the external auditory canal which on biopsy showed carcinoma. She was given 6,000 r (unfiltered) to her external auditory canal in a period of one week. She apparently had a satisfactory response to therapy but two months later developed otorrhea again. Pain became progressively more severe and a mass developed in the preauricular region. She had pain with chewing. Four months after her irradiation she was referred to us.

On examination there was a tender, hard, pre-auricular mass, 2 cm. in size, overlying the zygomatic arch and adherent to the skin. Another indurated mass was present over the insertion of the sternocleidomastoid muscle which felt like a matted group of lymph nodes. The external auditory canal was filled with exudate that was blood tinged. There was granulation tissue present in the lining of the canal and the tympanic membrane was intact although its landmarks were not discernible. There was no facial weakness. Radiologic examination of the mastoid, mandible, zygomatic arch and chest was negative.

The operation was performed on July 22, 1950.

The skin incisions were outlined so as to resect with the specimen some pre-auricular skin and a portion of the pinna in the region of the external auditory canal. The parotid gland, facial nerve, condyloid process of the mandible and temporomandibular joint were resected with the neck specimen. Posteriorly malignant tissue was closely adherent to the splenius capitis muscle and required a generous excision. A small portion of hidden tumor behind the mastoid tip was of necessity removed as a separate specimen after the mastoid resection was completed. A very radical mastoidectomy was performed as previously described. The wounds were closed leaving a small defect over the excavated bone. Microscopic sections showed a very anaplastic squamous cell carcinoma. (Fig. 7A and B.)

The postoperative course was as follows: The patient was relieved of her pain completely and the wound healed well. On the eight postoperative day x-ray therapy was begun. The portal included the area near the jugular foramen and the middle ear region. She received 5,250 r (unfiltered) at 250 kv. in one week. Two days after completion of therapy a split thickness graft was placed in the fossa produced by the extensive excavation at operation. This healed satisfactorily. The patient was discharged from the hospital three months ago. She has recently developed a small recurrence in the neck on the side of the operation which was implanted with radon. Metastases developed on the contralateral side of the neck and have been treated with x-ray therapy.

SUMMARY

Histories of five patients are presented to illustrate a procedure that is of value in the treatment of carcinoma in the external auditory canal and middle ear. Three of these patients had primary carcinoma of the auditory canal involving the middle ear. One patient had recurrent carcinoma originally arising in preauricular skin and later invading the face and middle ear. The primary site of the tumor was never determined in one patient but the growth secondarily involved the external auditory canal and middle ear after previous resection of the cervical mass.

Pain was the predominate symptom in all of these patients with advanced disease. Four of the five were completely relieved of the pain, no longer requiring narcotics. The fifth patient had some relief of pain following the operation. The elimination or reduction of pain is justification for this radical operative procedure.

All patients had involvement of the lymph nodes; in three the nodes were palpable preoperatively and in two metastases were found on microscopic examination. It is to be emphasized that all patients with cancer of the external auditory canal or middle ear should have radical neck dissection in continuity with wide removal of the primary disease.

Case II was free of pain and demonstrable disease seventeen months after operation. She then died following an injury.

Case I died nine months postoperatively after a two-day illness without external evidence of cancer.

Case III died probably of cancer two months after operation.

Seven months after operation Case IV developed a small recurrence in the neck outside the field of postoperative x-ray therapy. This recurrence received intense irradiation. The patient died nine months after operation, presumably of malignancy.

Case V is comfortable but has metastases to the opposite side of her neck and a small

recurrence on the ipsolateral side of the neck. She is still under treatment.

It is reasonable to hope that the early radical operation of neck dissection and wide removal of the primary site as herein described will produce an increasing number of good results.

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DÉBRIDEMENT

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DÉBRIDEMENT originates from the French language and is derived from the original word bridle which we, in English, are accustomed to use most often as part of a harness in order to restrain or confine, as with the horse. The addition of the prefix de meaning from gives, therefore, a literal translation of unbridling. Originally the word was used in a medical sense by the French to denote primarily the more adequate opening of the wound for better drainage and later added to this the meaning of removal of any foreign material in the wound. In World War I (1914–1918) it came into prominent use in the discussion of the treatment of war wounds and from there on was used widely in the English medical literature. Today it is used daily in the discussion of wound care and has become so fully anglicized as to have the verb débride and adjectives débrided and undébrided. The connotation of débridement as used today has, however, been disputed, and agreement is a must if we are to understand its use correctly in writing and discussions. Wrongly or rightly, in the English vocabulary we have given to it in its application to wound care the connotation: the removal of all foreign material and aseptic excision of all contaminated and devitalized tissue. We now review the history, argumentation about the word use and the English dictionary definitions of the word débridement.

Language is a living medium ever changing and new words to denote a special meaning are added. Another motive today is to employ words that encompass a greater meaning—words that say "more with greater economy." Such a word is débridement.

The word appears first in medical literature in the writings of Ambrose Paré, in the writings of Desault in 1789 and later in 1812 by Larrey.[1] These authors employed it in relation to wound care and gave to it the French interpretation: "To release tension in the tissues by incision; the removal of any foreign body." Reichert[2] in his interpretation of Larrey's writings concludes the same. Débridement first came to connote the present full meaning of excision of devitalized tissue with World War I with the discussions of the allied medical officers, namely, Lemaitre (French Army), DePage (Belgian Army), Gray (British Army), and Crile, Finney and Ireland (United States Army).

As to when the procedure was first used is a different consideration. Desault did speak of it in relation to wounds of the face, and possibly Larrey employed it as Lewis[3] in his paper of 1919 states; no doubt before 1914 many astute surgeons recognized the procedure as so essential and valuable. Tinker[4] in 1909 wrote of this in relation to wounds with compound fractures; and since Tinker in his youth studied extensively abroad, he may have heard in 1898 Paul Friedrich giving the results of his scientific research in regard to contaminated wounds, time element and treatment, for the procedure is based upon the scientific researches of Paul Friedrich.[5] Paul Friedrich[6] was born in 1864 and died in 1916, at which time he was Director of the Surgical Clinic of the University in Königsberg. (Fig. 1.) In his immediate postgraduate study he spent three years in the precision methods of bacteriology and it is said "he saw surgery predominantly through the eyes of a bacteriologist." He had considerable war surgery experience in the second Balkan war and in the First World War when he served as General Chief Physician and Consulting Surgeon of the First German Army Corps in the field. He was conscientious in his studies and work and was of great influence in German surgery. It is said he had posted in his clinical lecture room the words of the great Immanuel Kant: "No document is true without a background of experience." Friedrich summarized his contribution to wound care in 1898 entitled "Aseptic Treatment of Fresh Wounds, with Report of Animal Experimentation on the Incubation Time of Infection in Fresh Wounds" as follows: "1. Every non-operative contused wound infection i.e. so-called spontaneous

FIG. 1. Paul Friedrich 1864–1916.

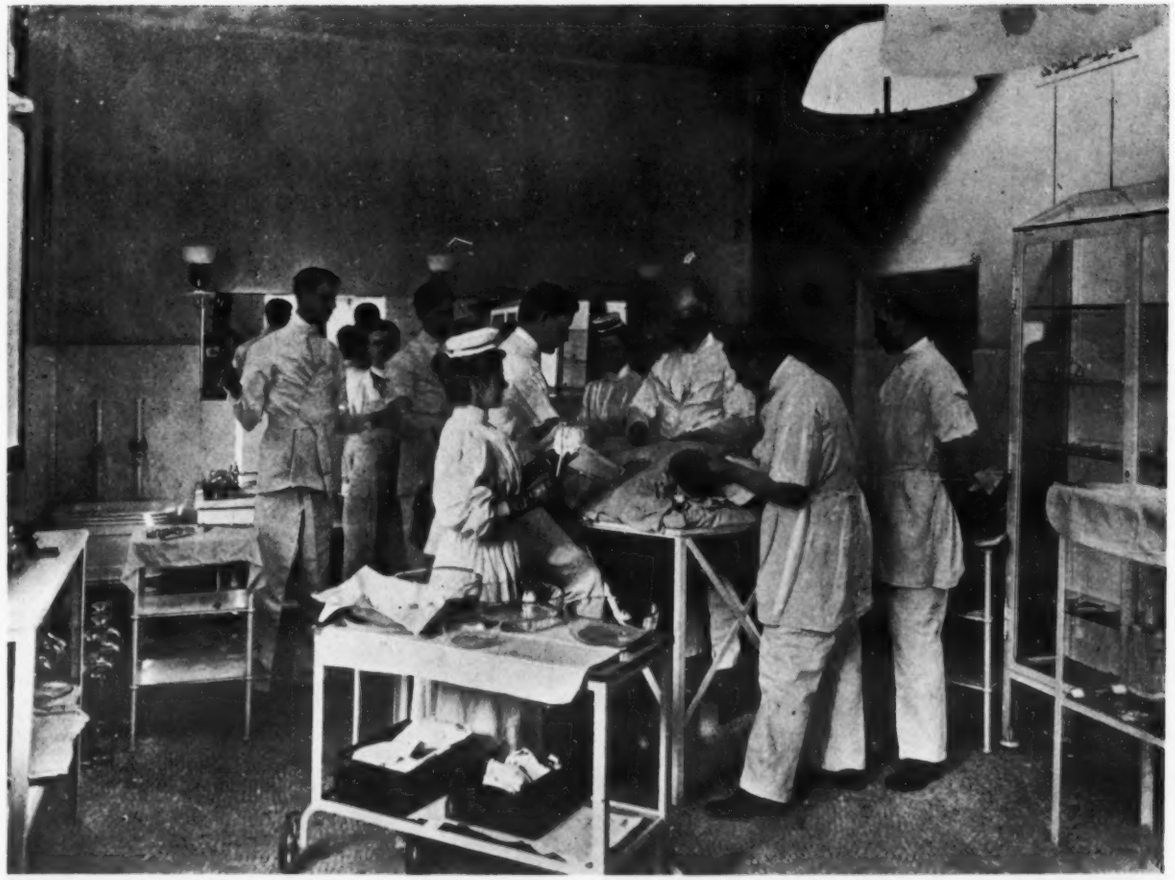
wound infection, is first a local process. For therapeutic and prognostic purposes, it is important to reckon that in by far the greatest number of cases it remains so for at least six hours, often longer, or even permanently. This time interval must certainly represent the incubation period of infection material (time of latency of infection, incubation time). 2. Of the procedures undertaken within this time allotment, precise excision (anfrischung) of the infected area into the healthy tissue, and extension of the traumatized region are the most reliable means of securing uninfected healing."

John Hunter[7] in his treatise on gunshot wounds recognized to some extent the role of devitalized tissues for he stated: "Part of the solids surrounding the wound is deadened and is afterward thrown off as a slough." LeMaitre[8] in 1918 in a series of lectures emphasized the clinical application of the sum knowledge of traumatic wound care in its development from the recognized period of surgical delay noted by Desault and Larrey through the period of incision and adequate drainage stressed by these two same men to the then present period of "war trimming," removal of foreign bodies, all dead tissues or tissues destined to die. This wound care was also spoken of in 1918 often as the "abortive treatment" and because it was so routinely done at the Evacuation Hospital as the "Evacuation Hospital Operation." Other names as wound excision, primary wound excision and wound revision were commonly used. It was at this time débridement first appeared in the English medical literature and began to be used in the present English definitional form.

A review of our American medical dictionaries gives the following: Dorland's[9] dictionary: "A procedure used in treating wounds consisting in the removal of all foreign matter and devitalized tissues in the vicinity." Stedman's[10] dictionary: "1. Division of constricting or restricting bands. 2. Cutting away a zone of contused or infected tissue from a wound surface, Cf. epluchage." Gould's[11] dictionary: "*In surgery*, removal from a wound of foreign material and devitalized tissue." Skinner[12] in his book states: "French—de plus bride, bridle; thus 'unbridling,' used in medicine for the cutting away of tissue. Originally the term was used for the cutting of constricting bands, hence the meaning of 'unbridling.'"

From 1940 to 1945 the use of the word débridement was debated by several English authorities, namely, Morrison,[13] Mackenzie,[14] Bailey,[15] Ogilvie,[16] d'Offay,[17] Mouat,[18] Payne,[19] Archibald[20] of Canada, and Page.[21] Ogilvie's opinion which we share was interestingly put: "It would be unfortunate if arguments based on history or etymology were to succeed in removing the word *débridement* from its present useful place in the vocabulary of war surgery. . . . Language is a sensitive and living medium, always growing and changing, always adapting itself to the spirit of a people and the needs of a time. New words come and old words acquire new meanings. If they are clearer, more beautiful or more striking than those they displace, if they say more with greater economy, they survive, and the old word and the old meaning become obsolete. To employ them after they have disappeared is either pedantic or meaningless."

Payne as an abstractor in the Second World War period for *War Medicine*, a British journal of the wartime and one of the best sources of war surgery articles, used and influenced the use of "surgical revision" as the preferable term. In the Italian medical literature of 1941 we find débridement used in its larger connotation, and in a Russian article in 1940 débridement is likewise employed. Trueta[22] in the Spanish medical literature at first held to the



Typical operating room at the beginning of the century. Professor McBurney, famous for his discovery of the McBurney point used in the locating of appendix trouble, is seen performing an operation.

Bettmann Archives

French definition of *débridement* but later, in 1940, used the term "thorough débridement" and stated in his text "the removal of all foreign matter, the excision of all the tissues immediately surrounding the wound, including devitalized soft parts in the vicinity and the opening up of cellular spaces—is known as débridement." The French continue to use the term in the narrower sense; for example, Leriche, one of their best representative contributors to scientific literature, described in 1940 the French view employing the word excision to what we Americans understand today as débridement. Leriche says "meticulous and complete excision under aseptic conditions of all that is mortified or contused in a wound, in order to render it aseptic by eradication of the area required for infection to develop." Hook[23] in an American College of Surgeons war session program in 1942 held precisely to the original French definition, but in the same session others employ débridement in the English connotation. In the U.S. War Department Technical Bulletin Medicine No. 147[24] in 1945 the term "excision of devitalized tissue" is employed by the Chief Officer, yet in the discussion of cranio-cerebral wounds débridement is used in the larger or English sense. Suffice it to say a review of the contributions published in America shows the decided majority employ débridement in the American-English definitional form.

CONCLUSION

Because "language is a living medium, always growing and changing"; because today with the increased tempo of life we demand alphabetic abbreviations and words that mean "more with greater economy"; because our English dictionaries already have defined the word in the full sense that usage by the English-speaking people has encompassed its full meaning; since leaders in the Italian, Russian and Spanish surgical field employ the word in its full understanding; and since by development and usage in a rich historical, almost sacred, background having to do with the saving of lives of those who were willing to give their lives for others, in other words, representative of the "spirit of our time," let us use the word débridement and its derivatives to connote the full meaning—"removal of all foreign material and aseptic excision of contaminated and devitalized tissues."

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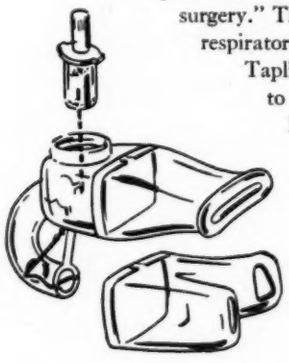

Taplin et al.[1] state that nearly all organisms infecting the respiratory tract are sensitive to either penicillin or streptomycin and that these drugs in micronized form for inhalation appear to offer definite advantages over other methods of administration. Further, "that prophylactic measures used to prevent the accumulation of bronchial secretions have materially reduced the incidence" of postoperative pneumonia. Against penicillin-susceptible organisms, the AEROHALOR plays an important role. The treatment is simple and effective—the patient simply "smokes" the AEROHALOR like a pipe. For comprehensive literature which discusses indications, dosage and clinical results, write Abbott Laboratories, North Chicago, Illinois.

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1. Taplin, G., Cohen, S., and Mahoney, E. (1948), Prevention of Postoperative Pulmonary Infections, J. Amer. Med. Assn., 138:4, Sept. 4.

2. Krasno, L., and Rhoads, P. (1949), The Inhalation of Penicillin Dust; Its Proper Role in the Management of Respiratory Infections, Amer. Prac., 11:649, July.

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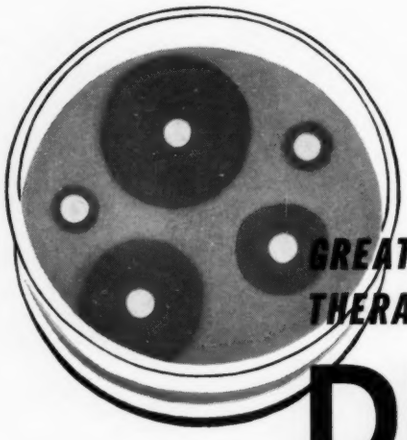

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Outside the Ivory Tower

(*continued from page 30*)

STATEMENT by Vice Admiral Joel T. Boone upon the occasion of taking the oath of office as Chief Medical Director of the Veterans Administration: "I have made a study of the medical program in which the Veterans Administration is associated with leading medical schools throughout the Nation. I know that the cooperation given to the Veterans Administration by the American medical profession has been—and is—magnificent. It is an accomplishment of which it has a right to be proud. I know that top-notch medical care for veterans is basic Veterans Administration policy—to that policy I wholeheartedly subscribe. Consequently, the present close-knit association of the Veterans Administration's Department of Medicine and Surgery and Deans' Committees and teaching medicine has my complete support. An interruption or disruption of this program would be a dis-service to veterans and to the nation. I pledge you I shall bend every effort not only to continue the program but to seek ways to strengthen it."

PROFESSIONAL nurses sounded a warning to the Wage Stabilization Board that "policies which ignore the peculiar problems of nursing will be disastrous" and only lead to "deterioration and depletion of nursing service." This warning was contained in a statement delivered to Wage Stabilizer Cyrus S. Ching by the American Nurses' Association. The association called on the Wage Board for development of policies which will support present efforts to overcome the critical nursepower shortage. ANA represents more than 175,000 registered professional nurses in every state, the District of Columbia, Puerto Rico and Hawaii. "Nurses face extraordinary obstacles in their efforts to improve salaries and to eradicate long-standing conditions of exploitation," the statement declared. Nurses are handicapped in correcting unsatisfactory conditions by their own voluntary surrender of the strike weapon. Also, special exemption of nonprofit hospitals from operation of the Labor-Management Relations Act of 1947 handicaps collective bargaining negotiations. "As a result, the registered professional nurse is at the lowest point, relative to comparable groups in our economy, in many years," the statement pointed out. The nurses fear that imposition of government restrictions on their earnings at this time will precipitate exceptional problems.

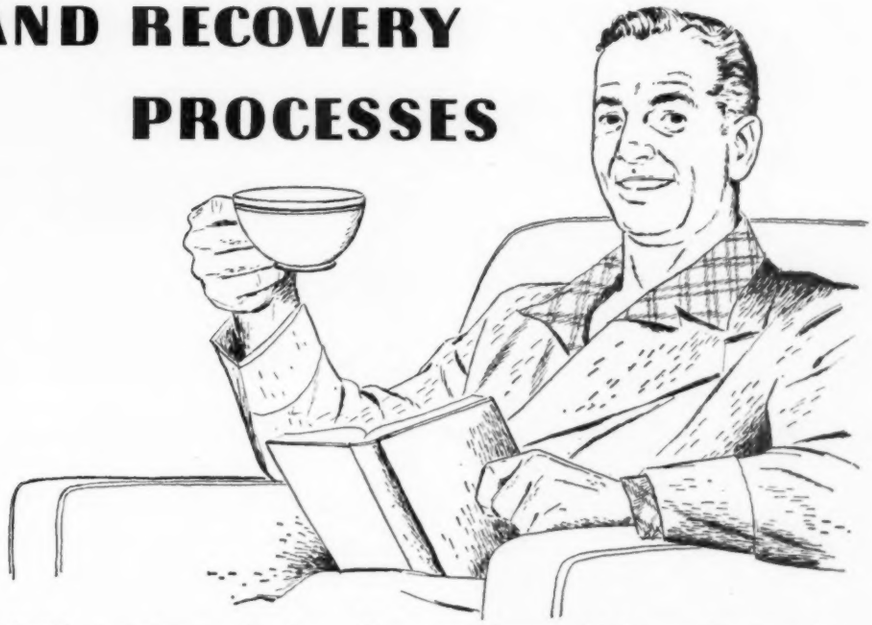
EACH year hundreds of fatal accidents to infants in the United States could be prevented by the person caring for the child, according to the Metropolitan Life Insurance Company's statisticians. This is borne out by a detailed study of fatal accidents during the first year of life among insured babies. The most frequent fatal accidents, are those resulting from the swallowing of foreign objects—nipples, pacifiers, safety pins, buttons, marbles or other things—left within the baby's reach, and from asphyxia caused by the regurgitation of milk and other liquid foods. Such accidents as burns or scalds from makeshift vaporizers, fires started by older children playing with matches, strangulation caused by the child getting its head caught, poisoning and drowning in the bath also take a considerable toll of infant life, the study indicates. These accidents are due in the majority of cases to lack of proper care by the person, usually the mother, in charge of the baby. On the other hand, the statisticians point out that most deaths are reported as suffocation by bedclothes or pillows, causing great anguish to hundreds of parents.

BIRTH rates throughout the world sharply rose shortly after the close of World War II and have continued at high levels during the postwar years, Metropolitan Life Insurance Company statisticians report. In many countries the postwar birth rates have been the highest since the baby boom that followed World War I. Particularly striking gains were recorded in the United States where the 1947 peak was one and a half times the average of 1937 to 1939. Almost as marked was the upswing in such widely separated countries as New Zealand, France and Canada. Most of the countries had higher birth rates during the war than in the years just before the war started. In the United States, for example, the rates averaged 15 per cent higher in 1940 to 1944 than in 1937 to 1939, and in Austria, Sweden, Switzerland and New Zealand the rise from the prewar to the war years was even more pronounced.

"These facts suggest that the postwar rise in births in many of the countries was due not so much to deferment of births during the war as to the improvement of economic conditions from those existing during the depression decade of the 1930's," the statisticians observe.

The Post-Surgical Diet

AND RECOVERY PROCESSES



A highly nutritious and palatable liquid food frequently is accepted when the post-surgical patient is unable or unwilling to masticate and swallow enough solid food.[1] Rich in protein, vitamins and minerals, such a food beverage served before and between meals or with standard hospital diets offers a strategic dietary means for the early postoperative support of the anabolic processes needed for wound healing and convalescence.

Ovaltine in skim milk, or Ovaltine in skim milk with added skim milk powder, is an exceptionally palatable, easily digested dietary supplement rich in complete protein and essential vitamins and minerals for intensifying the diet of the post-surgical patient. Even a grossly deficient food intake may assume full adequacy and good balance in nutrient content when supplemented with Ovaltine beverage. Taken hot or cold, its delicious flavor frequently reawakens appetite in general.

Three servings of Ovaltine in skim milk provide the wealth of nutrients listed in the table given below.

1. McLester, J. S.: Nutrition and Diet In Health and Disease, ed. 5, Philadelphia, W. B. Saunders Company, 1949, p. 687.

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PHOSPHORUS	0.94 Gm.	ASCORBIC ACID	30 mg.
IRON	12 mg.	VITAMIN D	400 I.U.
COPPER	0.5 mg.	CALORIES	415

*Based on average values for skim milk.

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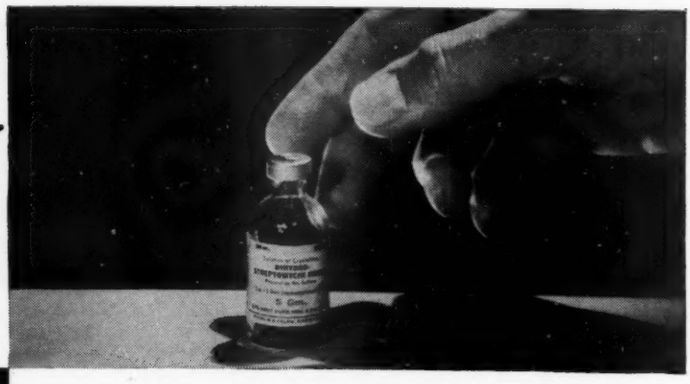

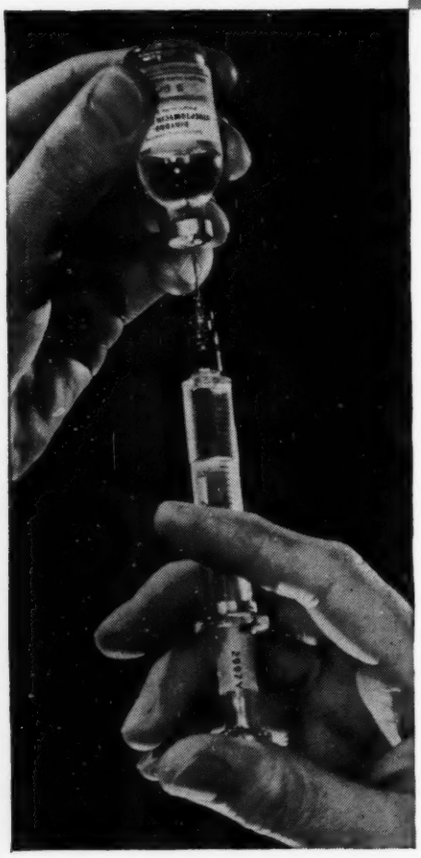

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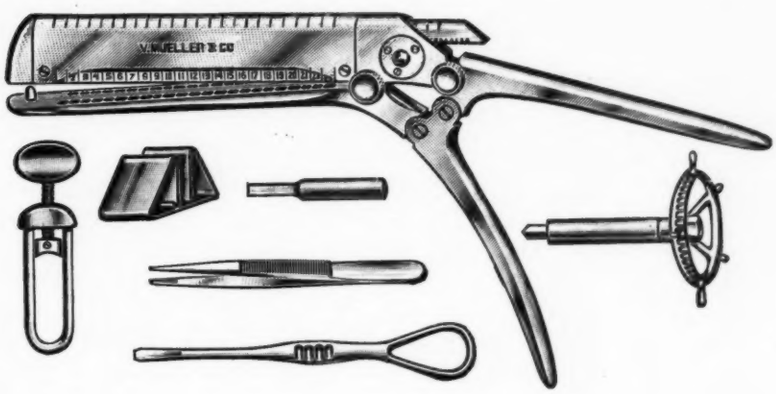

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1. McClintock, J. C.: N. Y. State J. Med. 1951 (In Press)

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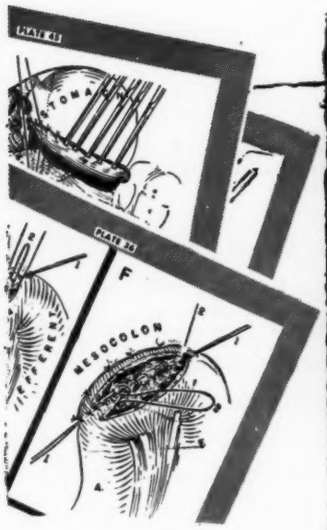

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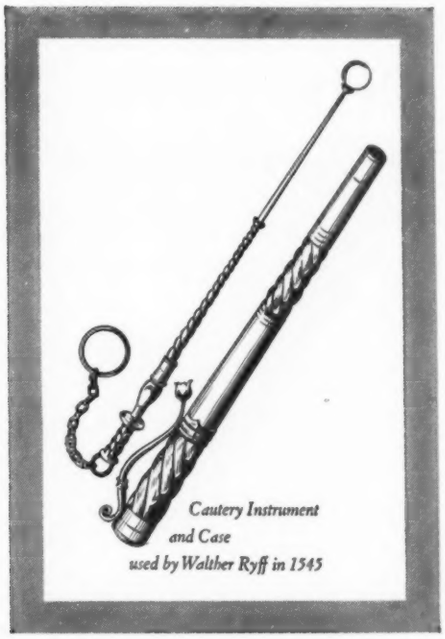

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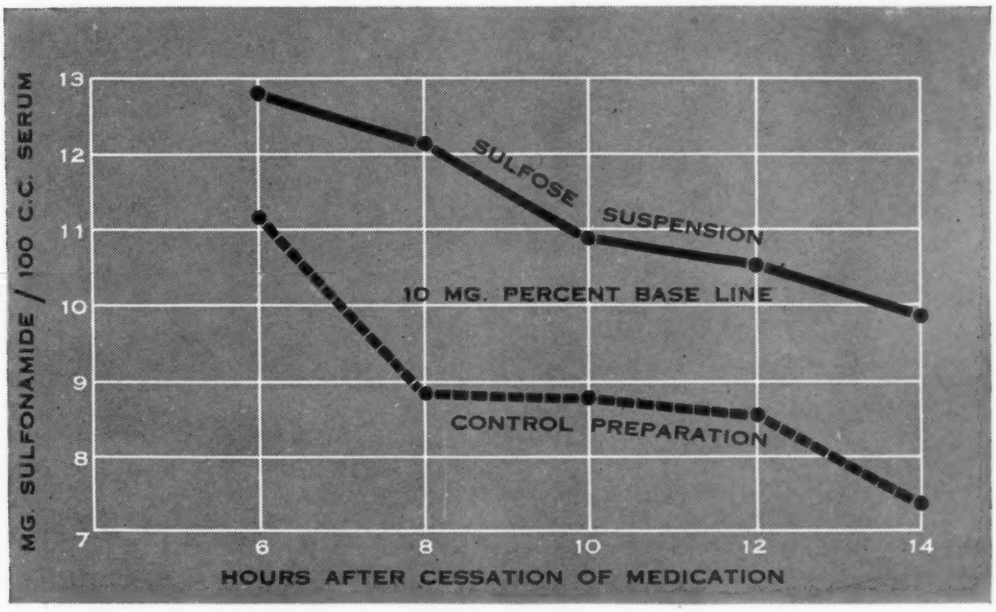

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